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IN THIS ISSUE:

MAKING THE MOST OF NIAGARA
THE WHY OF LUMINOUS PAINTS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

TAKING THE DENTS OUT OF DAMAGED BRASS INSTRUMENTS.—[See page 270]

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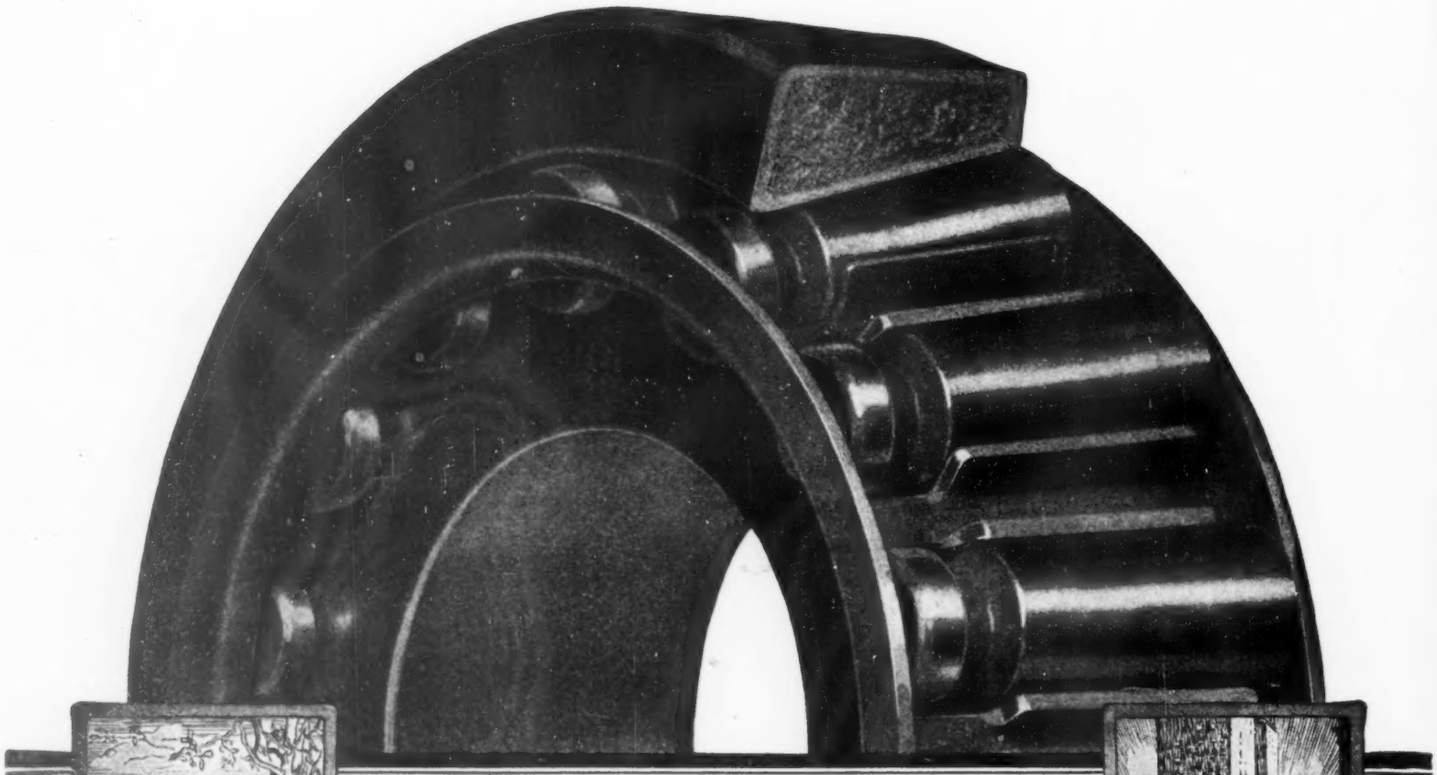

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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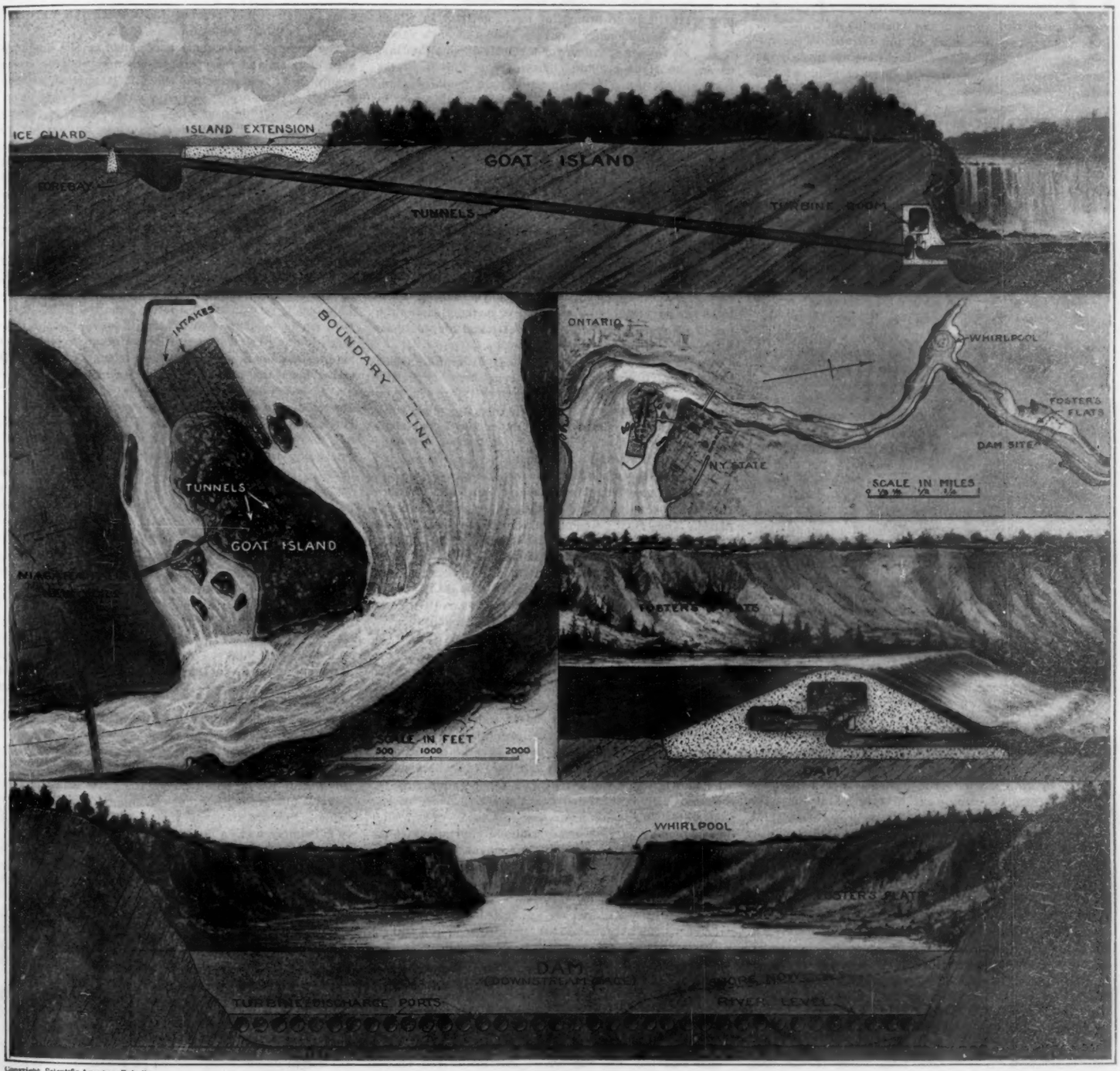

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THE PROPOSED HYDRO-ELECTRIC DEVELOPMENTS ON THE NIAGARA RIVER AT GOAT ISLAND AND FOSTER'S FLATS BY WHICH IT WILL BE POSSIBLE TO GENERATE 3,500,000 HORSEPOWER.—(See page 266)

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A Call for the Automatic Stop

ONCE more has a collision between passenger trains resulting in a shocking loss of life emphasized the necessity for the introduction of the automatic stop in the operation of railroads. It is the too-familiar story of the failure of the human element. The stage setting of this tragedy at Porter, Indiana, consisted in a level crossing of two main lines, each carrying a fast-passenger service, and a well-thought out system of block signals functioning with accuracy; and the tragic action consisted in the failure of the engine-man of one train to observe and obey certain signals which were set against him, with the result that thirty-seven people were killed and twenty injured.

Had the automatic stop been installed, the Michigan Central train would have been brought to a stop before reaching the crossing, in spite of the failure of the engineer to apply the brakes. The automatic stop, as such, long ago passed from the stage of the experimental to the class of the well-tried and widely approved invention. The supreme achievement of the automatic stop has been made in its use for several years in the New York subway systems, where millions of passengers have been carried at express speed under a headway of less than two minutes without the loss of a single life as the result of collision. We have never been able to find any reason why the automatic stop, with proper modifications and safeguards, should not be equally effective when used in the open on the trunk lines of this country. We say this with full appreciation of the fact that in the subways the stop is working under ideal conditions, free from rain, snow or ice. There are excellent open-air automatic stops available. Their application on such important crossings as this at Porter, Indiana, should be made obligatory.

But if legislation is enacted it should not be too sweeping. Universal use, just now, is impossible—the cost would be prohibitive. A bill should be drawn, covering all dangerous points that are subject to unusually heavy express service.

Do You Want an Airship?

GOVERNMENTS have at various times made gifts of considerable magnitude, but we doubt if there is any precedent for the giving away of fifteen million dollars' worth of highly developed and up-to-date war material. We refer to a cable dispatch announcing that the British Government is offering its fleet of large airships to any syndicate that will undertake to operate and experiment with them; the only condition imposed being that in return, all the data and useful knowledge acquired by such operation shall be at the disposal of the Government. Among these craft are the airship "R-36," somewhat larger but practically a sister ship to "R-34" which last year made a round voyage across the Atlantic to Mineola and back. "R-36," which has just made her maiden trip, has been adapted for passenger service and differs from "R-34" by being thirty feet longer and having a combined horsepower for her five-power gondolas of 1,570 horsepower, as against 1,250 horsepower developed by "R-34." In addition to this ship there are two others of the latest British-built airships, namely, "R-33" and "R-37," and also "R-32" and "R-80," vessels of a smaller rigid type. To these are to be added two huge airships surrendered by the Germans and known as "L-64" and "L-71." The total value of the fleet which is now offered as a gift is about fifteen million dollars.

Although the surrender of these vessels will be a serious blow to the naval service, the striking of them from the list by no means represents a total loss to the nation. If syndicates are formed with sufficient backing to take the vessels over and operate them in a mixed passenger and light package service, they may still be counted as a national asset. Indeed, in view of the necessity for severe retrenchment in naval and military expenditures, it is probable that the art of airship construction and operation will be promoted instead of hindered by the proposed transfer. In England, as in this country, private interests have been clamoring for government assistance. They have now received that assistance in a very tangible form, and the future development of lighter-than-air commercial aviation in Great Britain will be followed in the aeronautical world with the keenest interest.

The Hydrographic Office

THERE is no branch of naval activity in which greater efficiency has been shown or such valuable results obtained for a relatively small outlay, as in the Hydrographic Office of the United States Navy. It is not a large institution in point of numbers, and the total appropriation asked for this year is considerably less than one million dollars; but its work in aid of the navigator is known and appreciated on every ship, naval or merchant marine, that sails the high seas.

No better general description of the work of this office can be found than that contained in the Act of Congress by which, in the year 1866, this institution was established. It is described therein as "a Hydrographic Office for the improvement of the means for navigating safely the vessels of the Navy and mercantile marines by providing, under the authority of the Secretary of the Navy, cheap nautical charts, sailing directions for navigators and manuals of instruction for the use of all vessels of the United States and for the benefit and use of navigators generally."

But, in spite of the fact that the Hydrographic Office has been giving most efficient service for over half a century, it is now proposed to remove this work from the Navy Department and incorporate the office with the Coast and Geodetic Survey under the Department of Commerce. Now we all are in sympathy, or ought to be, with the present movement in the direction of reorganizing the administrative machinery of the Government by consolidating certain sections of its activities, thereby cutting out needless duplication and expense. The broad principle is a good one, but, like all other broad principles, it should be applied with discretion, and careful attention should be given to every individual problem before amalgamation is carried out. The Hydrographic Office is a case in point, and the proposal to amalgamate it with the Coast and Geodetic Survey, thereby taking a highly specialized branch of naval work away from naval men and putting it in the hands of civilians, who may or may not know anything whatever about the sea, could only lead to the work being less efficiently done, and probably at greater cost.

The provision of suitable charts and sailing instructions and the gathering of the large amount of miscellaneous information which is so eagerly sought and greatly valued by men who sail our ships, both naval and mercantile, to and fro upon the ocean highways, is essentially a naval job and the effective use of the Navy itself depends upon the possession of an adequate number of thoroughly reliable charts. Without them, should we be at war, our naval operations in distant parts of the world would be most seriously hampered. In this fact alone is to be found a sufficient explanation of the care which the Hydrographic Office devotes to its work, and we are satisfied that everyone who reads the article entitled "Twelve Hundred Charts at One-third of a Cent," which we publish elsewhere in this issue, will agree with us that we should let well enough alone and not transfer this important work from a highly organized and very efficient institution to one which in the very nature of things is not so well qualified for the job.

The Coast and Geodetic Survey covers not only the coast line but also the whole interior of the United States. There is yet another institution known as the Geologic Survey, which also is engaged in a survey of the interior. Obviously, if amalgamation is to be made, the logical step would be to combine the Geodetic Survey with the Geologic Survey and combine the Coast Survey, which is more a nautical than a land job, with the work of the Hydrographic Office. If amalgamation is what Congress seeks, here is one that might be carried out to very good effect and result in considerable all-around economy.

Summer Resorts and Water Supply

THE fight of the property owners and summer residents at Lake Hopatcong to prevent a group of Jersey City politicians from destroying the Lake as a summer resort will meet with a sympathetic response from those of us who appreciate the charm and restorative qualities of our lakes and mountain summer resorts. The proposal to divert the waters of Lake Hopatcong for the portable uses of Jersey City carries with it the imposition of restrictions which would prevent the use of the Lake for boating, bathing, fishing and so forth.

The right of condemnation of lands in the drainage area of lakes and reservoirs which are used for water supply is a good principle when it is applied to very sparsely settled areas, as in the case where new reservoirs are being built on sites far removed from centers of population. But if this principle be applied to bodies of water which, because they have never been considered likely sources of supply of potable water, have passed into the hands of thousands of private owners and have become the site of flourishing communities, a great injustice will be done. Moreover, the purification of drinking water on a large scale has become so simple and inexpensive a matter that the occupation of the shores of such bodies of water as Lake Hopatcong, Greenwood Lake and others by summer residents has ceased to be a risk to the public health. This fact is recognized in a letter from the Chief of the Division of Geology and Waters, Department of Conservation and Development of New Jersey, to one of the leading residents at Lake Hopatcong, in which he states his belief that it is impracticable and inadvisable to depopulate the watersheds of northern New Jersey, even where they are used as sources of supply. He makes the further statement that, in the future, only a relatively small part of the State's population can enjoy the expensive luxury of pure, raw water, drawn from uninhabited collecting grounds. It is certain he states that, increasingly, all surface supplies must be purified before they are used by the public.

Secretary Hoover on Food Research

IT comes with a shock of surprise to learn from Secretary Hoover that the United States must some time in the future pass from a food-exporting to a food-importing nation. The Secretary says this in a statement which he recently issued on the work to be done at the Food Research Institute which has been established at his suggestion in Stanford University and by the Carnegie Corporation. The new Institute will make a study of food distribution systems, the chemistry of manufacturing processes, and of production and agriculture. Milk and other commodities are to be traced and charts of costs, consumption and other data are to be compiled. The work of the Institute will be world-wide in its scope. Food-exporting areas of the world will be classified on the basis of their relations to our production and consumption, and to world trade. The question of transportation to and from each country will be analyzed and tabulated.

We regard this as one of the most important movements that has grown out of the experience of the World War and the terrible years that have followed. The work of the Institute, as thus outlined, will form one of the important agencies in the work of reorganization and reconstruction. It is understood that Mr. Hoover, who is a graduate of Stanford University and one of its trustees, will serve as a member of the Advisory Committee.

The Carnegie Corporation will provide 700,000 dollars for the support of the Institute for a period of ten years. The University will make its scientific laboratories available to the Institute, which will be careful not to duplicate equipment of research laboratories which are already working in the field of nutrition, but will endeavor to coöperate with all other agencies.

Naval and Merchant Marine

A Record Feat of Bunkering.—A new high record for rapid coaling of ships is reported by the Superintendent of Coaling Plants at the Cristobal coaling station, Panama Canal. The steamship "Pakeha" was coaled on December 24, 1920, with 1,002 tons, in one hour and ten minutes. So far as we know, this is the world's record.

The Present Shipping Situation. — It is estimated by Gordon Robinson, Editor of *Fairplay*, that thirty per cent of the world's tonnage is now out of employment, or 17,000,000 gross tons out of the 56,800,000 gross tons afloat at the first of this year. Every country is affected, including ourselves. It is estimated by E. S. Gregg that about one-half of the Shipping Board's 6,900,000 gross tons of steel tonnage is idle or awaiting assignment.

Shall We See the 20-inch Gun? — The tendency to mount naval guns of increasing caliber and caliber-length shows no signs of diminishing. We have gone from the 12-inch to the 14-inch and now to the 16-inch gun; the British built and actually used an 18-inch gun in the war, and in spite of the enormous increase in individual displacement of ships resulting largely from these heavy calibers, no one seems disposed to call a halt.

"Olympic" as an Oil Burner.—Since the "Olympic" was equipped as an oil-burning ship, she has undergone enlargement of her tank capacity. Last year it amounted to 5,068 tons. She has now a capacity for 7,555 tons of oil. The one-way consumption of oil, taken as an average over a period of voyages, is nearly 3,600 tons a voyage. The conversion to oil released about one thousand tons of space for cargo in the old bunkers, and other space has been used for pump rooms, et cetera.

Volume Versus Weight of Fire.—The "Tennessee" and the "Maryland" are of about the same displacement. One mounts twelve 14-inch guns, the other eight 16-inch guns. Since it is the shots that hit that count, the "Tennessee" with equal gunnery should make fifty per cent more hits than the "Maryland." Since she has equal speed, she could hold a range to suit her lighter gun. Would the heavier burst of a 16-inch shell outmatch the lighter burst of fifty per cent more hits by the 14-inch gun? Personally, we think not.

Submarines Cannot Sink Battleships. — Unless a battleship is traveling alone and unattended, something she should never do, she cannot be sunk by submarines. The late war proved this to a demonstration; for although the Grand Fleet was continually out in the submarine-infested North Sea, not a single battleship of the vast fleet was put down by submarine attack. The Germans were fighting a war of attrition; we may be sure that the submarines used every artifice to get at the battleships of the Grand Fleet. They were thwarted by the screen of destroyers.

The World's Construction of Ships. — The latest figures given out by Lloyd's show that, in spite of the present depression in the ship-carrying trade, there are over seven million tons of shipping being constructed throughout the world. This is made up of 921 ships representing a gross tonnage of 3,708,916 which are being built in the United Kingdom and of 1,059 ships of a combined gross tonnage of 3,470,862, which are being built by all the other countries of the world. The last figures do not include Germany, for which no statistics are as yet available.

Indirect Fire for Naval Guns. — In the United *States Naval Institute* for February, Commander D. C. Bingham states that the subject of "indirect fire" afloat is one of increasing and urgent importance, and is deserving of the greatest consideration by those concerned with progress in ordnance material, gunnery and tactics. He states that the destruction of the "Koenigsberg" in South Africa, the firing of the allied ships in the Dardenelles, the work of the monitors of the Dover Patrol, and the low visibility conditions in the North Sea have strongly emphasized the importance of this subject.

Early Hand-Power-Driven Naval Ships.—Eng.-Com. E. C. Smith, in a lecture recently given at Devonport, stated that the first power-driven ships of the navy were propelled by hand-worked paddlewheels. The 46-gun "Active" was thus operated at a speed of between two and three knots, by two paddles actuated by the turning of a capstan. Another small frigate was driven by paddles which were turned by means of winches. In this case, the speed was three knots. The *Naval and Military Gazette* tells us that, in spite of the hard work entailed, the seamen favored this auxiliary machinery because it enabled them to get into harbor when the wind failed.

Science

Leonardo's Airship. — The Division of Mechanical Technology of the United States National Museum has constructed and placed on exhibition a model of the flying machine designed and constructed in 1490 by Leonardo da Vinci. The model has been adversely criticised.

Weatherproofing Plymouth Rock. — This much-abused boulder, which has recently had its fragments united, is now being preserved against the elements. Even rock can be weatherproofed by chemical means, as in the case of the obelisk in Central Park, New York.

France's Population to Recover in Seventy Years.— Dr. Richard P. Strong of Harvard, lecturing at Johns Hopkins University, states that it will require seventy years for France to recover her loss in population brought about by the war. Dr. Strong places the entire loss of life at 43,000,000 for all countries and the total cost of the war $348,000,000,000. Dr. Strong probably does not exaggerate but the totals are staggering.

Swiss Glaciers Running Thin. — The drought in Switzerland is very unusual and is disturbing the economic balance, for navigation on the lakes is almost suspended and the cattle have to be driven long distances to obtain water. Many glaciers have broken and the moraines or "glacier terminals" are far up the mountains. There is less snow now on the peaks than in the normal August when mountain climbing is at its apogee.

Return of the Non-Magnet Ship.—The non-magnet ship "Carnegie" has reached San Francisco after having, as it were, completed an X-ray of the earth. Many of the best charts will have to be amended as the result of this voyage on a ship where even a steel hair spring in a watch is taboo. The "Carnegie" has traveled more than 300,000 miles since 1909. This gift of the kindly iron master has proved a treasure house of scientific research.

Cost of M. D.'s Goes Up.—It costs in the year of grace 1921, the sum of $4,600 to make a doctor and when he receives his sheepskin, which is a preliminary to the shingle, he has paid only $1,280 toward his education, the medical college paying $3,320 for the balance. Everything connected with medical education has advanced to such a point that if the schools were not heavily endowed, they would have to curtail their activities materially.

Gorgas Memorial Institute.—Researches in tropical medicine will be carried on by the Gorgas Memorial Institute in Panama and eventually a building will be built adjoining the Santo Tomas Hospital in Panama, with a statue of the great sanitarian in front. Three American physicians holding official positions will be sent, one a medical officer of the army, one from the navy and one from the United States Public Health Service. Assistance will be given by other institutions of tropical medicine all over the world.

The Calama Solar Station.—The Smithsonian Institution announces that its solar radiation station in Chile has been moved from Calama to a mountain 10 miles south of that place, where skies of extraordinary purity have been experienced. Telegraphic reports of observations which for the past two years have been sent to the Argentine meteorological service for use in connection with weather forecasting, are now also sent to the Brazilian meteorological service for the same purpose.

Again a Cure for Seasickness. — Remedies for seasickness come annually with the spring flowers but Professor Nolf of the University of Liege claims to have discovered a uniformly successful one in the shape of a milligram of sulphate of atropa on going on board, and additional doses of half this strength at intervals of half an hour. The professor does not explain how it affects the pneumogastric nerve, but it evidently does if we give credence to the excellent reports. Seasickness itself by-the-bye is supposed to be caused by a movement of the liquids of the internal ear which seems to affect the pneumogastoric nerve.

Robert Louis Stevenson as a Meteorologist. — The Stevenson family were lighthouse builders like the late F. Hopkinson Smith. Meteorology is a necessary science for the lighthouse builder to master. When he was 21 years old, the young Scottish novelist received a silver medal for a pamphlet on lighthouse illumination. This was followed by two papers on meteorology contributed to the Scottish Meteorological Society and the Royal Society of Edinburgh. The former society has just been merged with the Royal Meteorological Society of England, for Scotland is fast merging into England, "North Britain" being the first step to the dis-establishment of many things.

Aeronautics

The Lawson "Midnight" Air Liner has been designed and constructed by the Lawson Airplane Company of Milwaukee, Wis. It has been built especially for night service. The cabin is 65 feet long, and the wing spread is 120 feet. It has three Liberty engines aggregating 1,200 horsepower. The speed of this machine is said to be from 120 to 125 miles an hour and it can fly at a height of 25,000 feet. These figures are remarkable, it goes without saying. Sufficient fuel is carried for a 15-hour flight.

Duration Record.—At present the world's duration record stands at a little over a complete day—24 hours 19 minutes 7 seconds, to be exact—the performance standing to the credit of the Farman "Goliath." It may not stay there long, however, as a new Farman "Goliath" has been built with a view to making a continuous flight for 35 hours, according to *Flight*. Speaking of duration records, it will be remembered that Lieutenant Kilpatrick of the United States Army recently made a flight of 18 hours 5 minutes in a Curtiss "Eagle," being forced to land owing to a leak in one of the petrol tanks.

Greater Lift from the Wings.—The Glenn L. Martin Company of Cleveland, Ohio, has lately designed an airplane wing which can lift a greater weight per square foot than any other known wing, according to their claims. At 30 miles per hour speed, a model only 18 by 3 inches in size carried 4⅔ pounds per square foot. This is twice as great as the lift of the famous "R.A.F." 15 wing, and 25 per cent more than that of the Handley-Page high-lift wing, according to the only record published. The efficiency of the Glenn L. Martin new high-lift wing at high speeds is 10 to 15 per cent greater than the highest value ever recorded for any wing except the Parker variable camber airfoil. Again, it can not only carry great loads on planes of small dimensions, but for racing machines it is at the present time unequaled, according to the designers.

Steam Motors for Aircraft.—A short discussion of the lines along which experiment and development will have to be made, with reference to the present research of Germany and England on this subject, is contained in a recent issue of *Aviation*. The use of high-pressure steam is advocated, and the single-acting type of steam engine is recommended, owing to its absence of stuffing boxes, and simplified valve gear. The three-cylinder radial single-acting engine with variable cut-off, cam-operated, is stated to offer the most promise. Estimates are given showing that a 200-horsepower engine at 900 revolutions per minute, using 500 pounds pressure steam, should not weigh more than 400 pounds, the condenser weighing 100 pounds. This engine would require 14 pounds of water per horsepower hour and 1¼ pounds of liquid fuel.

Aerial Agreement Between Great Britain and France.—The text of an agreement between Great Britain and France regarding aerial navigation has recently been published in the *Official Gazette*. This agreement will cease to be in force as soon as the International Convention for aerial navigation drawn up by the Peace Conference becomes effective. The agreement provides that the two governments will permit the free passage of private and commercial aircraft, while reserving the right to establish prohibited areas for military reasons. All aircraft must carry a log and a traffic permit. The pilots must have a certificate showing their qualifications. The use of wireless apparatus without special permission is forbidden. The respective authorities reserve to themselves the right of examining aircraft on arrival and departure.

Speaking of Short-Lived Airplanes.—We have come to consider the airplane as a frail piece of work, which lasts but a few months when subjected to regular use. That may be so in the case of most airplanes, but there has been recently brought to our attention the story of a British seaplane of the Fairey type. Designed in 1916 as a seaplane, this machine was delivered to the R. N. A. S. in April, 1917. This seaplane was in service till after the armistice. In May, 1919, this machine was brought back to England, as a "Disposal" machine, being used to carry newspapers from Blackfriars to Thanet. During the summer of 1919, this seaplane was employed for experimental work. September, 1919, saw this same seaplane flown in the Schneider Cup Race, and it had the honor of being the only competitor to return intact under her own power. During the early part of 1920 this machine was used with amphibian undercarriages. Since then, it has been used for ferry work between Southampton and Sheerness. In all, nine engines have been used to a finish for the power plant of this seaplane.

Twelve Hundred Charts at a Third of a Cent

A Few Words About a Necessary Expenditure for Which Congress Has Failed to Provide

By C. H. Claudy

WHETHER the purpose of a navy is to fight or to prevent a fight may be open to discussion. But it is not open to discussion, whether a navy which has to stay at home can either fight or prevent a fight in foreign waters.

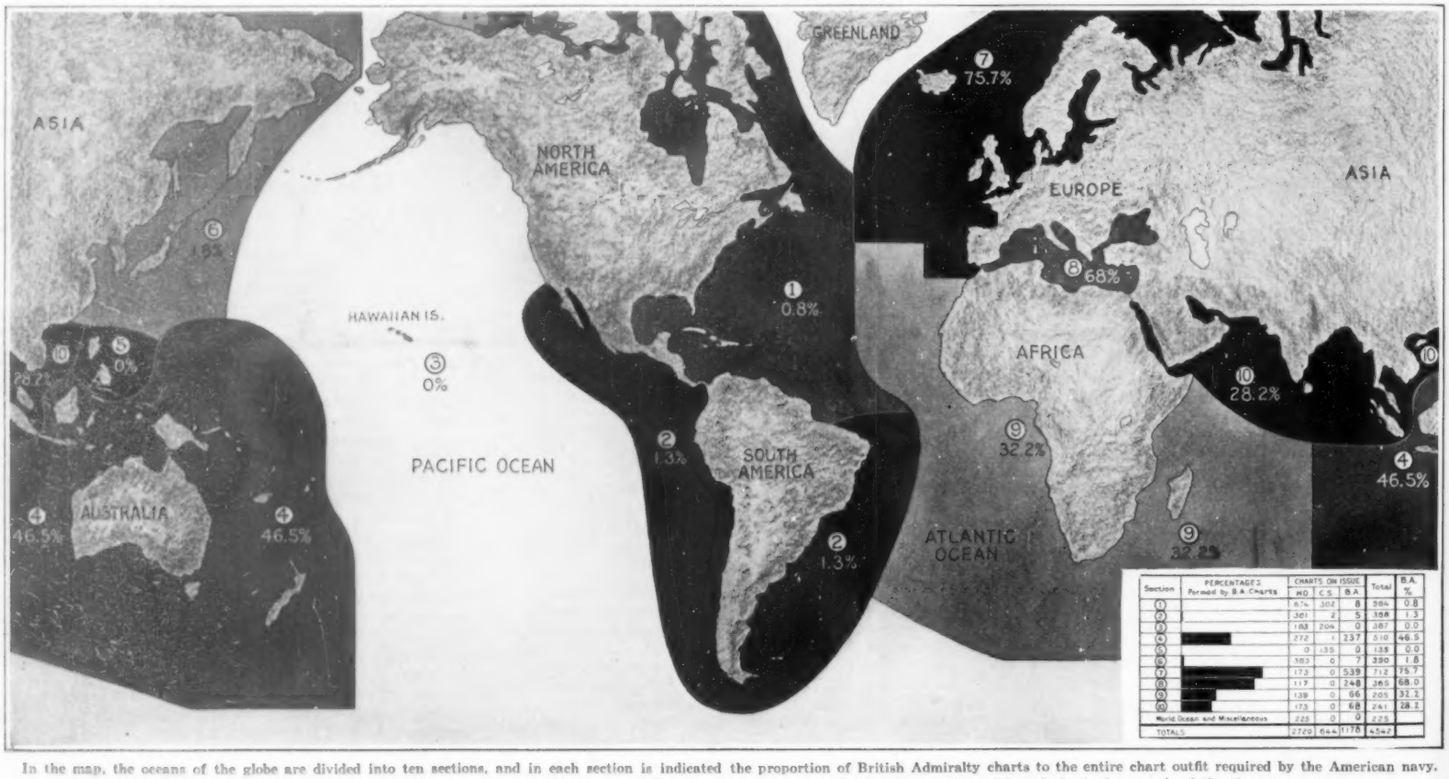
A navy is composed largely of ships. The ships carry guns and the guns must have ammunition and men to man, aim and fire them. But all the ships and all the guns and all the ammunition and all the men our navy possesses could not be applied to any war or war-prevention purpose, if the ships could not carry the guns and men and ammunition to the place where the trouble was or was to be prevented.

A ship cannot go in unknown waters without a chart, except at the risk of its total loss. A lost ship cannot fight or prevent a fight. It is evident, then, that as between a warship without charts or no ship at all, there is little choice, so far as action is concerned.

The United States has three sources of charts. One is the Hydrographic Office of the Navy. The second is the Coast and Geodetic Survey. The third is that maritime interests willingly take the risk of sending vessels into these uncharted waters, rather than forego the profits of such voyages. Of course, *some one* pays the bill of lost or damaged ships; and that some one in this case is the American people, who are hardly in a position to realize that one lost ship is more expensive than all the charts necessary to give her a safe voyage.

It is to many unthinkable that this country should ever have a serious difference of opinion with Great Britain. To most thinking Americans it is equally difficult to believe that any discussions we may have with Japan or Russia or the Fiji Islands or China should require a war to decide.

But wars have happened, and we have fought them. And if, for any reason, Great Britain happened to be neutral in such a discussion in which we took a leading part, or if she, for any reason, felt it inadvisable to continue the present cordial and friendly relations which exist between her and our Hydrographic Office, we might well find ourselves in the impossible position



Section	PERCENTAGES Formed by B.A. Charts	CHARTS ON ISSUE HO	CS	BA	Total	B.A. %
1		674	302	8	984	0.8
2		361	2	5	368	1.3
3		183	204	0	387	0.0
4		272	1	237	510	46.5
5		0	135	0	135	0.0
6		383	0	7	390	1.8
7		173	0	539	712	75.7
8		117	0	248	365	68.0
9		139	0	66	205	32.2
10		173	0	68	241	28.2
	World Ocean and Miscellaneous	225	0	0	225	
TOTALS		2720	644	1178	4547	

In the map, the oceans of the globe are divided into ten sections, and in each section is indicated the proportion of British Admiralty charts to the entire chart outfit required by the American navy. In the tabular insert the same information is given somewhat more fully, the three columns indicating the number of issued charts from each of the three sources—U. S. Hydrographic Office, U. S. Coast Survey, and British Admiralty

Where the charts come from on which our Navy depends

the world's supply of charts, as issued by foreign hydrographers. Of these, the British Admiralty is the largest and most important source.

Between Great Britain and the United States there exist the most cordial and friendly relations hydrographically. We use the British charts and they use ours. We take their charts, copy them, add to them, correct them, reissue them. They do the same with our charts. The world is a big place to go over with a sounding line, and the less such work has to be duplicated the more can be done. It is not only the navy which uses charts, but each and every ship that floats. The more charts, the better charts, the more easily accessible charts, the more ships can go to the more places and the less is the loss incidental to commerce.

At the present moment, the charts of Alaskan waters are sadly incomplete. Alaska has an enormous coast line, much of which is either uncharted or but little charted. Yet so great is the shipping need, and so far has commerce outrun charting in these waters of having a navy which couldn't go abroad for our interests, because we had not the charts which would enable us to go.

During the war the United States ordered charts from Great Britain in large numbers. Most of them were received; one case of a thousand charts was lost and never did turn up. It took on an average, three months to get them, often longer; and even then, if we were to reproduce them, the time would be greatly extended. So that if we had another war with any power in any part of the world, we would still be dependent upon our own supplies, or have to face the need of waiting until British charts could be obtained. It is not so much a question of being dependent upon Great Britain's good will as upon being dependent upon the natural limitations of time to manufacture, and to ship. And a war does not wait for a belligerent to get ready; it strikes as suddenly and with the opponent as much unprepared as possible.

At the present time the Hydrographic Office is twelve hundred plates behind a complete stock of British Admiralty charts. To obtain these plates from the existing charts will require, with the present printing plant of the Hydrographic Office, five years of time and the ridiculously small appropriation of sixty thousand dollars a year—a total of three hundred thousand dollars. This amounts to something less than a third of a cent, spread over five years, for each one of our hundred and eight millions. If the three hundred thousand dollars is not forthcoming at the present rate of progress, it will require forty years to become independent of Great Britain for charts.

The amount needed is so small, and the object to be gained so large that it would seem almost unbelievable that Congress should hesitate for a moment to appropriate it. But the gentlemen who make the laws are not naval men, many of them never saw a battleship or a chart, and have no knowledge of the relations of one to the other. A very able American once brought a large amount of ridicule upon himself by his oratorical reference to the million men who would "spring to arms overnight" in the event of an emergency. The ridicule came, not from the thought of the patriotism of our young manhood, but from the fact that they possessed no arms to which to spring. In the event of trouble to be started or stopped, the navy has ships and guns and ammunition, but it cannot spring to twelve hundred charts overnight, or over a year's time.

Some critic may observe "But why doesn't the Hydrographic Office pick out the important charts and copy them now out of its current funds?" To which the reply must be made that if any one of us all is a competent picker of the "important chart" he ought not to conceal his light under a binnacle but come right to Washington and pick.

The United States is dependent upon Great Britain for more than 75 per cent of the charts it may require for all the north and west coasts of Europe, for 46.5 per cent of the charts it needs of a very important part of the coast of Asia, and for various lesser percentages for charts in the rest of the world. For the whole world of charts, the United States must depend upon

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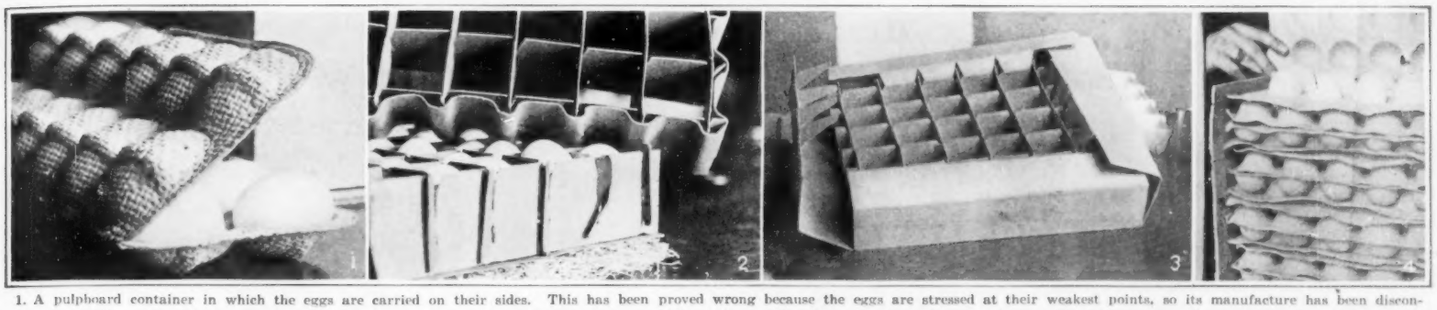

1. A pulpboard container in which the eggs are carried on their sides. This has been proved wrong because the eggs are stressed at their weakest points, so its manufacture has been discontinued. 2. When the old honey-comb containers began to go, the projecting edges would bend down or break, leaving the outer row of eggs without protection. The container illustrated prevents this by a corrugated reinforcement for the outer strips. 3. Another scheme for reinforcing the honey-comb container by locking it in an outer box. 4. One of the most successful of the new containers, a succession of sheets of heavy pulpboard with molded cup containers. This one carries the eggs on end and so avoids the objection made against the first one in this group

The old and the new in cardboard fiber egg carriers

When Humpty-Dumpty Travels

By Harry A. Mount

IN spite of the fact that cartons and containers for shipping eggs have always been a favorite subject with inventors, the same inefficient methods of packing and shipping which were used thirty years ago, when eggs were 15 cents a dozen, still obtain in 1921, with eggs at 50 cents or more per dozen.

The explanation for this fact is that shippers, and in fact all commercial handlers of eggs, have become so used to the old-time honeycomb egg crates that they are reluctant to change. But recent scientific investigation and a campaign of education undertaken among handlers of eggs, has emphasized the fact that the proper packing of eggs is a matter of considerable economic importance.

During the year 1920 the hens of the United States laid some 67,000,000 cases of eggs (each case containing thirty dozen), with an estimated value of $1,206,000,000. Most of these eggs moved a short, and many times a long distance, by rail to market. Most of them went by freight but many millions of dollars worth of the best "fresh laid" eggs were hurried to the cities by express. The express companies alone last year paid $1,267,000 in claims for broken and damaged eggs, averaging $105,000 a month. And this, of course, represents only a part of the loss because where damage could be shown to be the fault of the shipper, as through improper packing, the claims were only partially paid or not at all. The proportionate loss from breakage in freight shipments was much less than by express because the eggs were handled less, usually being loaded into a box car by the shipper, and being forwarded without rehandling to their destination. But many hundreds of thousands of dollars were lost through breakage during freight shipment and all of this adds a staggering total to the bill which is ultimately met by the man who likes "ham and—" for breakfast.

This loss has always been considered unavoidable, when it was considered at all, until recently scientific tests undertaken by express officials in coöperation with scientists at Cornell and Columbia Universities, have shown that this loss can be very largely avoided. Besides a number of tests to determine the best way to use the old style containers, twenty-two new types have been tested. Practically all of these new devices have been found superior to the old.

In the tests the eggs are packed as for shipment and then carefully measured blows are delivered to the sides or ends of the crates and the contents then examined. The most severe test given the containers is the tumbling test. A drum originally designed by the Forest Products Laboratories for testing various packing cases used for munitions during the war, is used. It is a hexagonal drum of metal with cleats so arranged on the inside that, when in revolution, it carries the crates of eggs upward and drops them in a series of falls ranging from one to seven feet. It would seem at first thought that no fragile egg could emerge whole from such a test, and indeed of 360 eggs packed in a standard container in the most approved way, 160 were broken and most of the others damaged. The best of the new containers made a record of three eggs broken in the same test.

Various methods of packing have been investigated in actual practise by making shipments from one investigator to another and then noting results. It has been found that in 75 per cent of the cases where breakage occurs, proper packing would have prevented it, even with the honeycomb container. One of the chief causes of difficulty, especially in small shipments of eggs, is the use of honeycomb fillers which have been used before. Nearly always the projecting tips of cardboard which are a protection against side shocks have been bent down and if the case is at all roughly handled the eggs on the outside row are almost sure to be broken. Another cause is the use of a "quarter-filler"

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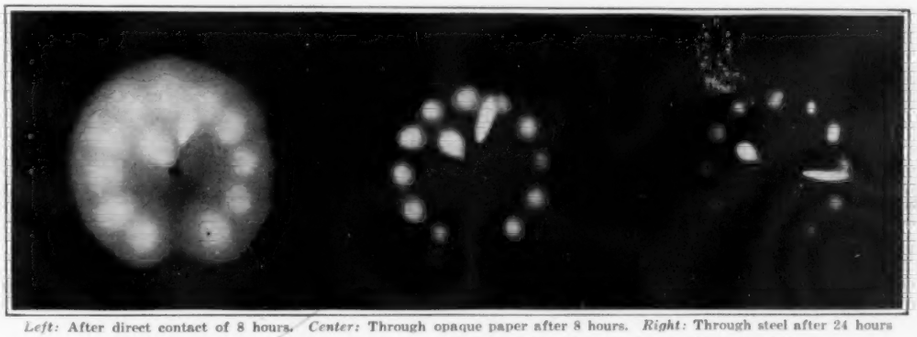

Left: After direct contact of 8 hours. *Center:* Through opaque paper after 8 hours. *Right:* Through steel after 24 hours

Action of radium-painted watch dial on photographic plate under various conditions

The Why of Luminous Paints

By M. A. Henry

FOR centuries the firefly has been envied by men of science; for the little creature did naturally that which science could neither reproduce nor explain. He made a perfect light, that is, a light in which all of the energy expended apparently was turned into luminosity.

But just as man-made mechanism has surpassed the eagle in the air, so men have given the firefly cause for envy in producing artificially a light which is well-nigh, if not indeed, perfect and which unfailingly glows year in and year out. If you would possess one of these "perfect lights" you have but to buy a two-dollar watch with an illuminated dial.

It is fairly well known that the mysterious element radium is in some way connected with the luminous material used for some years on the figures and hands of watches and clocks and which is finding a constantly broadening field of application; but the average man is puzzled to know how a material worth about $120,000 per thimbleful can be used to illuminate a two-dollar watch dial.

It is related that the existence of the substance which we know as radium was first discovered by the French scientist, Becquerel, while making experiments with phosphorescent substances. He left a piece of pitch blende overnight on a holder containing a sensitized plate. Later he developed the plate and found the outline of the pitch blende on it. He repeated the experiment and finally came to the conclusion that there was present some powerful penetrating ray which could not be explained as a mere manifestation of phosphorescence. It was not until the substance was isolated by Mme. Curie in 1898 that the substance was named radium.

Some thirty years have elapsed since Becquerel made his startling discovery and now, again, radium and phosphorescence are linked in modern radium luminous material.

What really causes this new substance to glow in the dark? Is it the radium we see? If not, what is the purpose of using radium in it? The answer involves the whole theory of phosphorescence, for it ought to be

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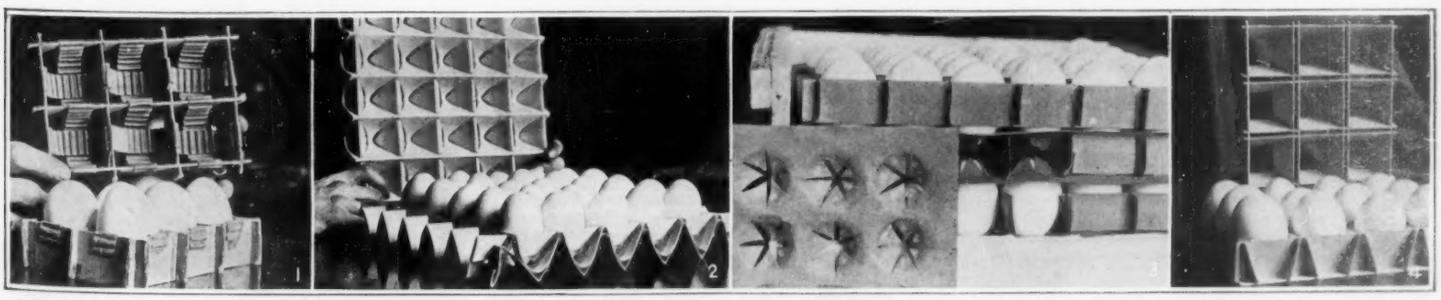


1. Holding the egg under tension by crossing two corrugated paper strips over and under it—one of many ideas of this sort. 2. A complicated carrier of heavy paper which puts the eggs under tension when the two halves are fitted together. 3. Honey-comb container, with special "flats" separating the layers. These have star-shaped cuts to take the tips of the eggs; and the design was, in the laboratory, the most successful of all. 4. Another tension device, which holds the eggs near their ends by fitting these into square cardboard receptacles

Four other designs which hold out promise of cutting the bill for breakage

Making the Most of Niagara

Projects Looking to the better Utilization of This Great Water Power

By Robert G. Skerrett

THE Niagara River will inevitably be utilized more extensively than now for the development of hydro-electric energy. The rush of those descending waters must be put to greater practical service wherever feasible without seriously impairing the scenic beauty of the Falls. Upon both of the governments concerned the people are making insistent demands for bigger blocks of power, and the authorities are listening sympathetically because of the logical promise of vast savings through the corresponding non-use of coal. No fewer than ten projects for water rights on the Niagara River have been filed with the United States Federal Power Commission, and among them are two that are sufficiently matured to warrant discussion.

Both of these contemplated hydroelectric propositions may well be considered as a single coordinated system, for they have been conceived and espoused by the same men, *i.e.*, T. Kennard Thomson, C.E., of New York City, and Peter A. Porter, of Niagara Falls. The dual project, as illustrated on the opening page of this issue, embraces first, the boring of tunnels through the massive foundation of Goat Island so that water may be led through them to large turbo-generators located near the river level on the down-stream end of the island, and, next, the rearing of a dam squarely athwart the river at a point 4⅔ miles below the Falls, thus submerging the present Rapids. The Goat Island tunnels would lie wholly on American territory, but the dam would stretch from shore to shore in the Gorge and be international in character. However, the citizens of this country would benefit by both of these engineering undertakings.

According to the existing treaty arrangement between the neighboring countries, it is not now permissible to divert for power purposes above Niagara Falls more than 56,000 cubic feet of water a second; and for certain reasons the American allotment of this is 20,000 cubic feet. It has been proposed that the combined total be raised to 80,000 cubic feet, and that each of the nations share equally. In other words, Canada would have 4,000 cubic feet more than is the case today while our volume of water would be doubled. If the suggestion be adopted, the problem will resolve itself into governmental selection of such of the proposed installations as would be apt least to mar the great natural spectacle, while giving the largest yields in energy and involving the fewest engineering difficulties of a debatable sort. The Goat Island scheme meets these desiderata in many particulars, and makes instant appeal to us, inasmuch as it would be located on our side of the river.

Goat Island would not have endured for ages in the erosive sweep of the Niagara but for the fact that it is an integral part of the massive ledge there underlying the river, and this has a very important bearing upon power development at that point. From the crest to the base of the Horseshoe Falls is a drop of about 165 feet, but the plan is to increase this head to substantially 200 feet by lengthening Goat Island. From east to west, along its major axis, the Island is today 2,800 feet long, but there is nothing to prevent extending it 600 feet by raising above the surface of the river the slightly submerged area at the upstream end.

By doing this it would be then practicable to drive the tunnels from water level to water level at a moderate angle and so insure a difference in drop of about 200 feet between the intake and the discharge ports of the conduits. At the same time, the bores in their entirety could be cut through solid rock. Each aqueduct, when finished with a concrete lining, would have an internal diameter of 20 feet, and the descending waters led by it would be capable of developing 100,000 horsepower through the medium of suitable turbo-generators. As now projected, only two tunnels would be excavated at the outset, furnishing 200,000 horsepower, but the physical conditions will ultimately permit a larger number.

As can be seen from one of the opening page illustrations, in sinking the tunnels it would be a relatively easy matter to rear cofferdams to hold the river at bay during construction work; and the only subaqueous excavating of rock would be that required for clearing out the forebay. To screen the tunnel intakes from logs, ice, etc., there would be built an L-shaped reinforced concrete wall, rising from the ledge of the river bed to a sufficient height above the surface to divert floating objects into the currents sweeping onward and over the two Falls. According to the engineering estimates, two tunnels can be cut and turbo-generators placed and made ready for service within an interval of two and a half years.

Today, in the vicinity of Niagara Falls it costs anywhere from $70 to $100 to generate by steam a horsepower year. If we strike an average, and call the outlay $80 per annum, it should be manifest that an economy of $120,000,000 in coal consumption may be effected while adding tremendously to the power available for industrial and other purposes. If it be assumed that a horsepower year in the run of steam plants calls for the burning of 8 tons of coal, then the substitution of hydroelectric energy will save each twelve months quite 12,000,000 tons of fuel which, otherwise, would have to be mined and transported from the nearest fields, those in Pennsylvania.

It is pertinent to emphasize here that in Buffalo, only about 25 miles distant from Niagara Falls, a big public service electric company develops two-thirds of its current at present by means of steam, and it is obliged to do this because it cannot obtain all of its energy from the comparatively near-by hydroelectric plants. Think of it, there within a stone's throw, so to speak, of the thunderous waters of the Falls, this concern has to rely upon coal to generate 80,000 out of the 100,000 horsepower needed by its customers. Thirty years ago, the population of Buffalo was 250,000 and is now 505,875, an increase of 198 per cent in three decades. The City of Niagara Falls, when incorporated in 1892, had a population of about 10,000, and in the interval it has grown 600 per cent owing principally to the influence of the availability of hundreds of thousands of horsepower in the form of electrical energy.

THAT the Niagara River is not yet furnishing sufficient electrical energy to meet existing requirements is evidenced by the Queenston-Chippawa development now being pushed to completion on the Canadian side of the international stream. As recently described in the SCIENTIFIC AMERICAN, *the plan is to generate at the start 210,000 horsepower and, later on, 472,500 horsepower. Recognizing the prospective greater demands for electricity in the course of the next few years, the projects discussed in the current issue are of timely interest. In the order of their preference, they are first, a dam a few miles below the Falls which will make use of the full flow of the river, and, second, an installation at Goat Island which, of necessity, would have to absorb waters that might diminish the impressiveness of the present Falls.*—THE EDITOR.

Indeed, electricity is playing its part throughout a wide zone lying around Niagara Falls—the primary source of power. Syracuse is drawing current from that point, 160 miles away, and the loss in transmission is less than 10 per cent at a voltage of 60,000. Using a potential of 110,000 volts, the Canadians are distributing current nearly 250 miles; and by raising this pressure to 220,000 volts, the radius of distribution could be lengthened to 500 miles. Under existing conditions, the five pioneer companies located at the Falls are developing 650,000 horsepower; and it is a matter of common knowledge what this has brought about in the realm of electrochemical industries. Visualize, then, what momentous evolutions in our productive capacity would be made possible if a million and a half more of motive current were at hand!

Four years ago, in the State of New York alone, the power requirements totaled something more than 3,000,000 horsepower, and the demand was then increasing under normal circumstances at the rate of 300,000 horsepower each twelvemonth. Therefore, if the Goat Island project were pushed to completion, and equipped to provide a maximum of 1,500,000 horsepower, there would be a market for every kilowatt-hour of its output within the span of a comparatively short while. It should be recognized, however, that this scheme would, of necessity, divert water from the Falls, and, according to the measure of this diversion, affect the volume and possibly the scenic grandeur of the cataracts. For this reason the proponents of this enterprise do not urge its adoption first, but advocate, instead, the construction of the dam farther down the river.

As an engineering undertaking, the dam proposed at Foster's Flats, a little less than 5 miles below the Falls, would be a much more ambitious enterprise, and would permit of the development of 2,000,000 horsepower of electrical energy. The plan is to take advantage of the drop of 102 feet in the river level between the foot of the Falls and the site chosen by rearing a massive structure, from shore to shore of the Gorge, 140 feet from the base line to the crest of the spillway. This barrier would raise the water level within the impounding area high enough to submerge the existing rapids and modify, at the same time, the character of the Whirlpool by making it larger and more impressive. But the scenic features of the Falls, themselves, would not be altered in any way. As a compensation for the obliteration of the Rapids, the dam would create a new cataract having a drop of 100 feet and would call into being a series of rapids quite as spectacular as those that now stand in the sweep of the river just below the Falls.

At first blush, the mere suggestion of building a barrier athwart the Niagara River, with its minimum flow of 220,000 cubic feet of water per second, seems little short of preposterous, knowing that the ceaseless flood must be allowed to pass steadily on while the proposed structure is in course of erection. But nature is ready to lend help which would make the execution of such a project far easier than one might imagine offhand. The walls of the Gorge above Foster's Flats rise sheer several hundred feet from the tideway, but contiguous to the Flats the Gorge is considerably wider, and on the Canadian side, especially, the bank slopes at a comparatively easy gradient, terminating near the river in a fairly expansive low-lying area. At the same time, the river's path is considerably narrower at that stretch of its run. Owing to this state of affairs, the Flats present a strategic base of operations from which to start the rearing of a dam. That is to say, something like 50 per cent of the contemplated structure can be completed on dry land before any of the work trespasses upon the present course of the Niagara at that point. Let us be more specific.

As designed, the dam has a spread in cross section of about 650 feet at the base, and 30 feet or more of this lower portion will reach below the line of the riverbed and have its footing on the underlying solid rock. With a total height of 140 feet, the dam will be of an extremely massive character. The bottom section of the dam—at least that half of it that will rise from Foster's Flats—will be pierced by large temporary openings of culverts, and channels will be dug to them on the upstream side to serve as sluiceways for the entire volume of the Niagara when it becomes necessary to divert the river in order to bare the normal bed for building purposes along the line of the contemplated barrier. With this done, it will then be a relatively easy engineering task to dam the usual or natural watercourse to facilitate excavating the rock and erecting that portion of the dam that will terminate on the American shore. When the dam is finished, then the sluiceways will be sealed and the waters impounded until they accumulate and carry the surface level back from the crest of the dam to the very foot of the Falls.

As most everyone knows, great quantities of ice are carried over the Falls and down the river during the winter and the breakup of that rigorous season, and the impact and the pressure of these floes must be withstood by any rigid obstruction rising in their path. Therefore, it is essential that these stresses be minimized and that the currents be free to carry the ice onward with a minimum of opposition while the bulk of the water is held in check. To this end, the dam will be fashioned with long slopes on the up- and the downstream sides. The heaviest of the ice should be able to mount the advance slope without difficulty under the impulse of the water beneath and behind it, and

(*Continued on page 279*)

A Problem of Electric Drive

The Advantages of the Diesel-Electric System Over the Straight Diesel Drive

BEFORE enumerating the advantages of the Diesel-electric drive over the simple or straight Diesel drive in which the engines and the propeller are connected to the same shaft, it would be well to describe briefly the make-up of the Diesel-electric drive unit.

The plant consists of one or more generating units, each comprising a Diesel engine of from 250 to 425 revolutions per minute, direct-connected to a direct-current generator. The generators are connected in series and supply current to one or more slow-speed motors, running at one hundred revolutions per minute, which are mounted on the propeller shafts. At the present stage of their development Diesel-propelled ships will usually be of the single-screw type.

The speed of the propelling motor is controlled and its direction of rotation is varied by means of a rheostat, which controls the field current of all the generators, the latter being separately excited. By moving the handle of a simple reversing rheostat or by pressing certain buttons, the exciting current can be varied from zero to maximum in either direction. The voltage of the current delivered by the generators to the motor varies correspondingly, and so do the speed and direction of rotation of the motor. The engines run at constant speed and in one direction at all times, regardless of the operation of the motor.

As to the relative efficiency of the straight Diesel and the Diesel-electric systems, it would seem at first sight that the straight drive would be the more efficient of the two, since there is an inevitable loss of from nine to fifteen per cent (depending on the size) in the electrical equipment. However, as shown by Commander S. N. Robertson (*Marine Engineering*, December, 1920, page 974), the straight-Diesel must ordinarily be used on twin-screw vessels, while Diesel-electric will be used, for the present at least, mainly on single-screw vessels, and there is a considerable loss in the twin-screw ship as compared with the single-screw, "which brings out the rather remarkable fact that for low-power cargo vessels, the Diesel-electric installation is actually more economical than the straight Diesel."

On the point of relative reliability, it must be noted that with the straight Diesel there will ordinarily be two large engines running at about 115 revolutions per minute, each connected to a propeller. If one goes out of commission, the vessel is in trouble; if both go, it is helpless. On the other hand, with the Diesel-electric there will be anywhere from three to six or more small engines, and if one or two fail nothing happens except a reduction in the speed of the vessel. Furthermore, because of their small size, the Diesel-electric engines can be more easily repaired at sea than the large, heavy, straight-Diesel engines. Another advantage is that a small Diesel engine is inherently simpler and more reliable than a large one, since its cylinders are more easily kept cool and no piston cooling is required.

In respect to the operation, the advantage is decidedly with the Diesel-electric, since the engine runs continuously in one direction when the ship is under way—it is not reversed nor is its speed changed. On the other hand, the heavy, straight-drive engines require a complicated reversing gear. A Diesel-electric operated boat can change from full speed ahead to full speed reverse in less than five seconds by a mere movement of a controller handle.

On the basis of weight and compactness it can be shown that, with the proper selection of the apparatus, a Diesel-electric equipment is lighter and more compact than a straight-electric equipment for the same ship, this for the reason that the high-speed engine is so much smaller than the slow speed straight-drive engine that a sufficient margin is left to include the electrical equipment and still have some margin in the matter of weight and compactness. However, it is conservative to rate both drives on an equal basis in these respects.

Although the first cost of a Diesel electric drive is greater than that of a straight Diesel drive when the propelling machinery only is considered, advocates of the former claim that, when everything is taken into consideration, the earning capacity of a Diesel-electric driven ship will be found to be greater.

As to their limitations of capacity, straight drive engines of 6,000 indicated horsepower each, or 12,000 total horsepower per twin-screw ship, are being built today. The upper limit of capacity for the Diesel-electric system is about 6,000 horsepower per ship, since this is about as far as electrical manufacturers care to go with this apparatus under present conditions. This does not mean that this limit cannot be considerably raised in the future.

Steel from Japanese Iron Sand

A METHOD whereby iron may be smelted from the volcanic iron oxide sand of Japan, heretofore regarded as wholly refractory, has been discovered by scientific experimenters working for the War Department of that country. While the discovery cannot be employed as yet commercially, the cost of the iron so obtained being too high to compete with iron smelted from ore, the value, from a military standpoint, of the process to Japan, which, like every other volcanic country, is rich in deposits of iron oxides, is regarded as being great, inasmuch as it may place that country in an independent position so far as its supply of steel for military and naval uses, where cost is not the deciding factor, is concerned.

A statement made by the War Office on October 18, 1920, said, with regard to the process, which is being guarded as a military secret: "Iron sand is so general throughout the entire length and breadth of the empire that it has long been plain that if some method were discovered of smelting the iron from it, Japan would never suffer from want of steel. On the strength of the above, the necessary investigations were started as early as September, 1919, by a special committee, with experimental offices established in the Aomori Prefecture, and with Dr. Kishi as chief engineer. The experiments of a year have now been crowned with tolerable success, and the process has been experimented with on a practical scale at the Penchihu works under the control of the Okura firm with very satisfactory results."

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Suggestion for Snow Disposal

To the Editor of the SCIENTIFIC AMERICAN:

A recent news item stating the enormous cost entailed in snow removal from city streets was of much interest to the writer. The abnormal increase in city street traffic in the last decade due to the constantly increasing number of motor vehicles has made this a paramount and gigantic problem facing all cities.

Weight and bulk are the prime factors in this problem, and, the slow, laborious and costly method of shoveling the snow into carts to be hauled away, different methods of melting the snow so that it will run into the sewers and others have all proved either impractical or totally inefficient in anything like desirable results. Melting the snow seems to be the best method yet tried out, but, when the atmospheric temperature is below 32 degrees, which it nearly always is in time of snow, unless the water quickly reaches the sewers it will freeze and do more damage than the snow did.

The writer, a high class mechanic and inventor, has given this problem considerable attention, and, what seems to him a practical means of overcoming the handicap of not only weight and bulk but transportation as well, will be described:

By the use of a cylindrical rotary sweeper or a vacuum device on a motor truck, the snow would be swept up from the street and pressed into a cylindrical mold of say, about three feet in diameter and four feet in length with a core of about three inches through the center.

This drum-mold to be in either two or three segments so that it could be quickly released from around the snow after compression, this arrangement being easily accomplished by having it hinged or pivoted together with one point of contact releasable with any kind of latches and also a slightly tapered core so that when the snow cylinder was turned out this core could be quickly drifted out by tapping its small end.

The purpose of having this hole in the longitudinal center of this compressed cylinder of snow is for the insertion therein of a suitable length of say two-inch pipe to function as an axle, and, by any number of means, a chain or rod hooked to each end of this pipe makes of the whole an easily moved roller, and any ordinary motor truck would be able to tow a train of from four to fifteen of these snow cylinders to a point of disposal.

A cylinder of this size would contain approximately twenty-eight cubic feet, and as snow is compressible to from four to ten times its original bulk, depending on pressure used, a space of one hundred square feet of a one-foot snow fall could be pressed into one of these snow "rollers" with pressure sufficient to reduce bulk four diameters.

It will be seen that these snow "rollers" may be easily dumped into a convenient stream or moved to and left on unused lots or rolled into any ravine.

On account of the peculiar "texture" of snow, any pressed mass of it has much greater tensile strength than an equal mass of ice, and it would be much less liable to be broken by rolling on the paved street than ice in the same form.

It would be necessary of course to open a passageway through the snow to point of final disposal, for the adhesiveness of both the roller of snow and loose snow on the ground would cause the roller to "grow" like a small boy's snow man.

In severe snow storms, the snow could be pressed into these roller shapes and moved to the gutter in nearby infrequently-used streets until final disposal could be made.

On residential streets the snow could be pressed into either square or rectangular blocks and piled up on the curbs just in the clear of the street where they would melt and run into the gutters.

Washington, D. C. C. J. MENASCO

Where Some of the Fish Go

To the Editor of the SCIENTIFIC AMERICAN:

I was glad to see your article in the SCIENTIFIC AMERICAN of Jan. 29th, on the question, "Are we abusing our water resources?" Would have liked it much better if the question had been more general—something like this: "Are We Properly Conserving Our Fish Supply?"

The greatest destroyer of fish, next to themselves, is the water fowl. Strange to say, the most numerous and destructive kinds are protected by the law, and vast breeding grounds set aside for them, and a penalty imposed for killing them.

None of the fish-eating fowels is useful to man in any respect.

The increasing scarcity of all kinds of fish is due more to the increase of these fowls than to increased consumption by man. The quantity of fish caught in the Gulf of Mexico is decreasing every year and the price is getting higher.

When I first visited the Gulf coast, fifty years ago, schools of sardines and red fish, covering hundreds of acres, could be seen often. Now it is a very rare sight to find a school fifty feet square.

What has become of these vast schools of sardines? There are no canning factories on this coast to use them, and they have never been caught by the fishermen. The only answer is, they have furnished food for the vast and continually increasing flocks of sea fowl.

I have talked with many who have had long experience on the Atlantic and Gulf coasts; and one man, of unusual information along this line, said that he had estimated that the number of pelicans in the localities frequented by the fishermen of these waters exceeded one million, and that at a low estimate each consumed one hundred fish per day, a total of one hundred million fish per day by this one variety of sea fowl, and the pelican is exceeded in numbers by the gull more than three to one.

It is a reasonable estimate to say that all other varieties of fish-eating fowls consume twice as many as the pelican, which makes a grand total of three hundred million per day, or about three fish for every man, woman and child of our nation.

When I write to the Congressmen they reply that we have a fish commission whose duty it is to look after every phase of this question and that they have not recommended any legislation for protection against the water fowl.

Mr. Roosevelt boasted that he signed the bill setting aside certain islands in the Gulf of Mexico as breeding grounds for all kinds of fish-eating fowls. When such men as he can be influenced to commit such a crime what may we expect from our fish commission?

Meridian, Miss. J. M. T. HAMILTON.

Left: Using sawdust as fuel in Georgia. *Center:* A Colorado sawmill which, on the face of its showing, might fairly claim to be a sawdust factory. *Right:* Sawdust blower in operation at a big sawmill

Where sawdust is made and how it is used up

Jobs for Sawdust

Some of the Useful Ends to Which This Waste Material Is Being Put

By S. R. Winters

THE towering sawdust heap, once considered the veriest of waste and but a shameful monument in betraying the movements of the sawmill in denuding our already depleted forests, is being salvaged to useful purposes. The old-fashioned pile of pulverized particles of wood is rapidly disappearing. So self-evident is this truth that the Forest Products Laboratory of Madison, Wis., challenges anyone to discover a vast accumulation of the seemingly worthless material where the arteries of railway facilities course, or in proximity to cities. A striking epitome, almost unbelievable, attests to the fact that 51 profitable uses have been developed for the utilization of sawdust.

From manufacturing soap and fertilizers to the purification of gas and in lettering floral emblems, the range of its recovery is well-nigh limitless. Green sawdust, barring its consumption as fuel, is narrowly restricted in utilization. Once dried, however, the pulverized particles are adapted to a half-hundred uses. Commercial concerns in large cities have made its recovery a business, invading wood-working establishments, planing mills, sash and door factories, and furniture establishments for the hitherto accumulated heaps of refuse. The material is transported to the plant of the sawdust company in wagons and delivered to the ultimate consumer in bags or bulk consignments. Sawdust is graded with respect to species and fineness, the latter requirements being insured by sifting screens capable of yielding varying degrees of fineness according to a diverse market. Resaw sawdust may be one classification while particles from sanding machines constitute another grade. The latter is described as wood flour, although radically differing from the product employed by manufacturers of explosives and makers of linoleum.

THOSE of us who are acquainted with the old-fashioned lumbering operations will have a vivid mental picture of an abandoned temporary mill-site carpeted with a foot or even more of the sawdust of yesteryear. This substance was in good fact more or less of a nuisance; nothing could be done with it, nothing could be done to it save burning; and no profitable means of doing this was at hand. Today, however, lumbering is on a different scale, and the sawdust is available at a given point in such quantities that means for burning it not alone economically, but with actual utility, are easily at hand. Yet such is the rapid march of science that the sawmill man is by no means obliged to use his wood meal for fuel. Half a hundred other and better uses are open to him; and it is mainly of these that Mr. Winters tells us.—THE EDITOR.

The utilization of sawdust in the manufacture of fuel briquets is in its infancy. One commercial plant in Los Angeles, Cal., is in operation, and a similar establishment has been erected in Vancouver. The briquets are fashioned in cylindrical shape, are three and one-half inches in diameter, and of varying lengths, with 12 inches prescribed as a happy medium. Special machines are purchasable, and Europe is producing fire lighters from sawdust. The latter is sandwiched with rosin or pitch and transformed into compact cakes, which are scored to permit small pieces to be broken off with ease. Milady's fur is not impervious to the refining influence of the pulverized material as the saw rips its way through huge monarchs of the forest. Furs are renovated by being tumbled in drums where sawdust acts as an absorbent in extracting grease and dirt.

Hams, bacon, fish, and sausage may be pickled or cured under the smouldering fires of hardwood blocks and sawdust. A desirable flavor is thus imparted and the preservative qualities of these products strengthened. The meat absorbs the smoke from four to five days while the temperature hovers around 75 degrees Fahrenheit. The method can be hastened by increasing the temperature. While green hickory sawdust is a popular favorite, particles from the maple, oak, walnut and even mahogany, have their adherents. Widespread use is made of sawmill refuse as an absorbent on floors, meat and fish markets, hotels, abattoirs, machine shops, garages, factories and warehouses being consumers in this particular. The abandoned or reconverted barroom once was a claimant of the material as an absorbent on floors. Of minor consequence, although used in some instances, is its adaptation as an extinguisher of oil fires. Dry sawdust is employed effectively for cleaning and drying metals. The latter when cleaned in a pickling bath, or when subjected to a plating solution, or greasy pieces produced on automatic machinery in which they are deluged with a stream of oil, may be dried in sawdust and polished to a most pleasing effect when subjected to agitation and more or less intense friction in a tumbling barrel.

As a bedding in stables the subject of this article has a limited use, although shavings have excessive claims. The former is considered a better absorbent. Twenty concerns in the United States make and lay composition flooring, which is constituted of a base of magnesium oxychloride, formed by the reaction between magnesium oxide and magnesium chloride. Substances serving as fillers are of a varying character, but sawdust is one. Its percentage in composition floorings varies from 4 to as high as 50. Ethyl alcohol has long been a product of sawmill waste, the material being inserted into rotary digesters, and treated with dilute acid at a high temperature, thus converting the cellulose into fermentable sugars. These are then separated and fermented into alcohol. There are promising developments under way looking to the destructive distillation of hardwood sawdust though commercial operations have no tangible support. Hardening and annealing of metals is another very limited method of utilizing waste from the buzzing saw; the product acts as an insulator in avoiding too rapid cooling of steel.

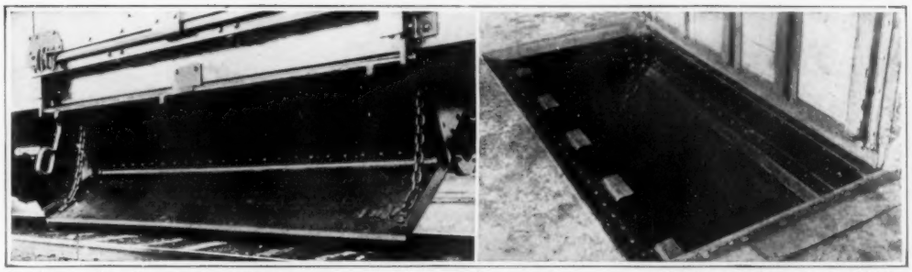
In the consignment of canned goods, as well as fragile articles, sawdust is a protector. It affords insulating influences in cold climates and thereby prevents the freezing of liquids in transit. Likewise, the material is suitable for insulation purposes in the construction of ice houses, refrigerator cars, and storage houses. Sound-deadening is a term associated with the offerings of the sawmill but other materials have displaced its use in this particular. Meat is shipped in Europe by this prescription: "Entire unboweled cattle or large suitable severed pieces are sprinkled with acetic acid and then packed and transported in sawdust impregnated with cooking salt and sterilized." Grapes from California course their zig-zag routes across the continent when enveloped in sifted redwood sawdust. Soaps, recommended for use by mechanics, are on the market, sawdust being their major ingredient. Waste from the lumberman's equipment is frequently used in a partly charred state either alone or mixed with wood ashes as a fertilizer.

In at least one instance, sawdust has displaced sand in the making of a cement barn floor. The testimony subscribes to its merits which consist of warmth and a minimum of wearing on the hoofs of cattle. It likewise shares the distinction with finely chopped straw as a filler in burning clay products. It meets the requirements of the manufacturer of porous clay bricks and tile for some substance for consumption during the burning and thereby leave the finished product filled with fine cavities or pores. Purification boxes filled with a mixture of iron oxide and shavings are used in coal gas plants and producer gas plants for removing the sulfur from the gas. Experiments are being made in producing paving blocks and some asphaltic binder from this pulverized wood, although results are not yet available. One plant in the United States is producing oxalic acid from sawdust, and the product has commercial possibilities in the manufacture of carborundum and calcium carbide. Charred sawdust in the electric furnace is the method of approach. The drying of fresh concrete can be delayed by spreading a layer of the waste from the lumber mills to a depth of three or four inches.

Plants have been erected in the Pacific Northwest with the view of producing a gas of high calorific value from the distillation of wood under high temperatures. Such plants bear similarity to ordinary coal gas equipment, the wood being distilled in gas retorts. The resulting charcoal can be consumed directly under the ovens, or can be burned in a water gas plant, the gas from which can be diverted into the mains. Oatmeal wallpaper utilizes sawdust for its distinctive surface, while it is employed in decorative lettering in a fashion similar to the manufacture of raised wall paper.

Making the Box Car a Dump Car as Well

IN order to increase the uses to which the usual box car may be put, there has recently appeared a new type of box car in which special hopper bottoms are provided. The details of these hopper bottoms are brought out in the two accompanying views, which show, first, the outside hopper and chute arrangement, and secondly, the hopper trap doors and frame inside the car.



Outside and inside views of the hopper mechanism of the new box cars provided with dumping facilities

It is hoped that this new construction will materially facilitate the handling of grain and other loose materials in box cars. By removing a pin the bottom of the car opens up and the contents come through the chute on either side of the tracks. There is no opening mechanism, the doors being closed and opened by a simple locking-bar arrangement. If the contents cannot be dumped through the hopper, then the car is used in the same manner as the ordinary box cars, being provided with the same kind of side doors.

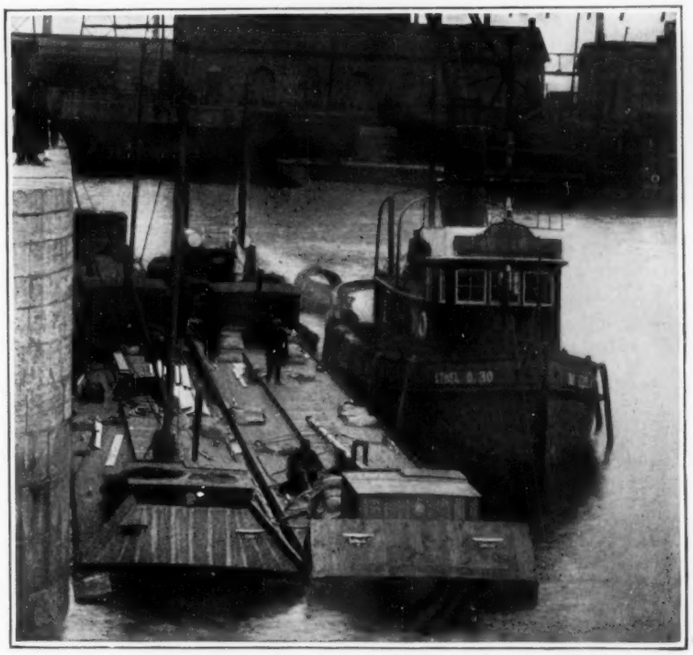
Tank Scows for Live Fish

FOUR blunt nosed scows arrived in New York harbor the other day, after a twenty-four day voyage down the coast from Quebec, Canada. They moored at the docks of the Fulton fish market, and there unloaded their cargo of 200,000 pounds of live eels.

Now these scows are no ordinary plodders, but are the first live-fish carriers in the Western Hemisphere. Their appearance marks the beginning of an attempt to supply the American housewife with live fish instead of fish which has been dead for a week or more. The designer of these fish carriers is Gottfried Friedrichs, who in addition, is director and part owner of the enterprise. They are patterned after Scandinavian and German models, declares Captain Friedrichs.

"They are simply long narrow rafts," he explained. "Water-tight compartments at both ends enable them to float. Between these compartments at the extremities, there are seventeen smaller ones through which the sea is passing all the time. In these the fish are kept, and swim about. The holes in the sides which admit the sea are not large enough to permit the fish to escape."

That, in brief, is the principle on which the vessels were built. Three of them are 110 feet long, and the fourth is about half this length, or 48 feet. The smallest of the fleet has two gasoline engines which enable it to travel under its own power, whereas the others have only a rude steering gear and are compelled to depend on a tug.



Two tank scows which recently carried a large supply of fresh fish from Quebec to New York City

In quiet water, however, and with a fair wind, the larger scows can dispense with towage, for each scow carries a twenty-five-foot mast, from which a simple lateen sail may be flown. The sail is useful in navigating rivers and as an aid to steering when at sea. Captain Friedrichs asserts that next year he will equip the three large scows with engines, thereby bestowing on each craft the power of self-propulsion.

The water-tight compartments, both forward and aft, are utilized as sleeping quarters for the crew. These are marked by deck houses rising above the deck level to a height of six feet. Each house contains accommodations for two men and an oil stove on which food may be prepared. The men "grub" for themselves.

From the end of the ship to the point where the fish-containing compartments begin, the distance is ten feet. On each scow there is, therefore, twenty feet of water-tight, air-filled space for the purpose of giving buoyancy. This is more than sufficient for the purpose; in fact, the wood used in the construction was so new and untried that it was necessary to add no less than five tons of ballast to each scow.

The wood used in the scows is British Columbia fir. All of each vessel, not even excepting the bottom of the tanks, is constructed of this wood. A metal construction would prove injurious to the fish, according to Mr. Friedrichs. The tanks taper from the deck width or beam of twelve feet to the width at the base of ten feet. Their depth is three feet which is the draught of the scows. The opening of the tanks on deck is two and a half feet, and the opening is covered and barred in a manner similar to hatches aboard other vessels.

The hatch covers are thrown off at sea and the fish examined by means of long hand nets. The fish that have died or fallen sick are sorted out and cast overboard. This is hard work at any time, and it was especially hard on the recent voyage, due to the fact that there was only a skeleton crew aboard. There is provision for a crew of fifteen, including the captain, aboard the scows.

The eels which were brought to New York on the recent voyage were caught by means of 150-foot traps stretched across the St. Lawrence River. The eels swimming down stream swim into the traps which are made up of closely-meshed chicken wire. This wire cuts off their retreat and the fish wind their way into a box-like arrangement from which they can be scooped by the trapper.

A small vessel with a sharp prow, built with tanks for containing live fish, collects eels at the various traps, and then discharge their collections into the scows which wait day after day until their tanks are full.

Heating Water with Exhaust or Live Steam

THERE has recently been placed on the market the ingenious storage heater shown in the accompanying drawing which is intended to furnish hot water in hotels, apartment houses, factories, etc. Exhaust or live steam is supplied to the heating element, where it condenses and heats the water in the tank.

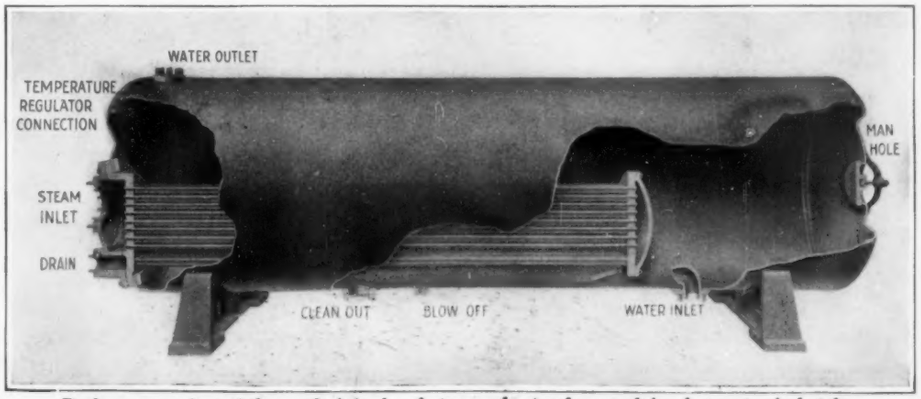
The storage type heaters insure a reservoir of hot water at all times. In their general form they have been on the market for years, but the present storage heater departs from the general practice as regards the construction of the heating surface. It has been standard practice to use U-tubes for the heating element of a storage heater. Careful study and experimentation have established the fact that practically all of the work of heating is done in the upper or outgoing portion of the U-tube, and that the lower row or return portion of the U-tube simply acts as a drain pipe and returns the condensed steam to the steam head. It is, therefore, obvious that in a U-tube heater practically half of the tubing is useless as a heating medium.

Furthermore, a certain volume of steam, when condensed, will occupy only about 1/1600 of the volume of the steam. Therefore, the large area of drain tubes in the U-tube type of heater is absolutely unnecessary and waste material.

The present storage heater is designed with a certain number of straight tubes in the steam element, and these tubes are of sufficient length to insure that the required heating will be taken care of and all of the steam will be condensed when it reaches the rear end of these heating tubes. It is therefore necessary to provide only a sufficient area of drain tube section to carry the condensation back to the steam head.

The heating surface consists of seamless drawn brass tubes expanded into a fixed tube plate at one end, and a floating tube plate at the other end, permitting expansion and contraction of tubes without strain of the tube joints. This straight tube construction, as contrasted with U-tube, eliminates the necessity for removal and scrapping of a large portion of the tube surface to replace an inner tube, as is the case in U-tube construction. These straight tubes are all of the same length, and this reduces the spares necessary to be carried in stock, and in fact permits the purchase of stock tubing to replace worn out tubes.

The various features of the new storage heater are clearly brought out and labeled in the accompanying drawing.



Broken away view of the newly-introduced storage heater for supplying hot water in hotels, apartment houses, etc.

The Musical Hospital

How Flattened and Fractured Brass, Wood and Stringed Instruments Are Repaired

By Albert A. Hopkins

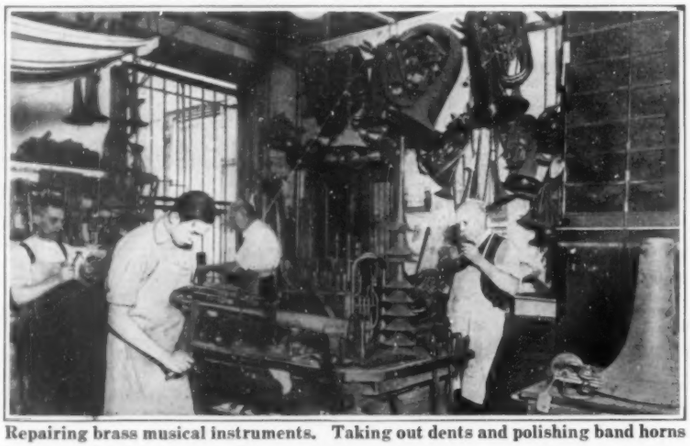
WHEN you go to the opera or a concert you see the conductor with his back to you and his face to the orchestra. On the left at front are the first violins, behind them are the violoncellos and the double basses. In the center are flutes, piccolos, oboes, English horns, clarinets, horns, bassoons, trumpets and drums; on the conductor's right are the second violins, violas, tubas and trombones, while in the center at the back are the instruments of percussion. Such is, in brief, the orchestral scheme. Few people, however, when they view a perfectly balanced orchestra, realize that many of the instruments are subject to accidents which, for a time, incapacitate them from giving forth their accustomed sounds. It is our privilege to show some illustrations of what might be termed "a musical hospital," which has advantages over the ordinary hospital in that there are no ambulances and the patients never die. So the atmosphere is always cheerful and "atmosphere" is used advisedly for there is no other place on earth with so much local color as a musician's repair shop. Of course there are foreign musicians with the flowing ties and the uncut if not unkempt hair which go to make up the artistic personality. But for most of the artists their instruments are their breadwinners and few musicians achieve such a meed of success that they have many replicas of treasured instruments.

The things which can happen to a musical instrument are legion. There may be a train wreck, a trolley car may go wrong or an automobile run over the musical treasure, but all is grist to the repair shop. It should be stated, however, that instruments are grouped into classes and a man who repairs brass does not try his hand at the wooden wind instruments, such as flutes, oboes, clarinets, saxophones and bassoons; while the stringed instruments have special and highly skilled surgeons all their own.

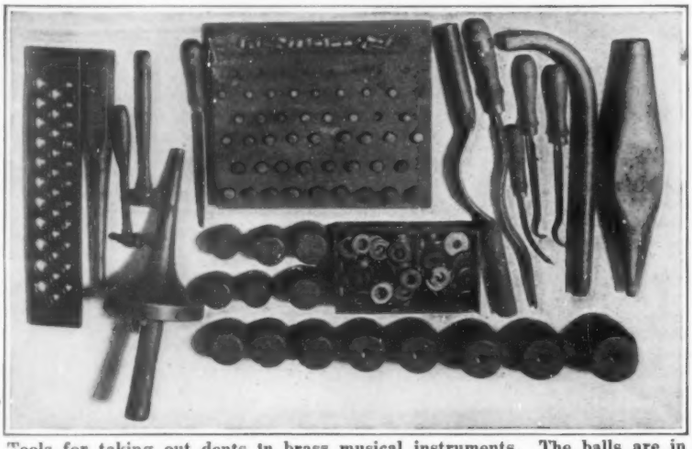
The brass instrument shop is the most picturesque of all, which may be gathered from our cover engraving which we are permitted to show through the courtesy of Mr. H. Gerson of Carl Fischer's in New York. Here instruments such as horns, trumpets, trombones, tubas, etc., undergo revivifying processes so that the former owner would hardly know the rebuilt and refurbished instrument, for the great public likes an instrument not only without dents but highly polished or plated as well. Horns come in bent out of all shape and almost literally as flat as the proverbial pancake. Our first thought would be to consign the once tuneful carcass to the cellar of the junk man as old brass, but not so does the musical instrument repairer consider it. Men in this trade are of unusual intelligence and withal have a great love for their work. The most interesting operation is the taking out of dents and the reforming of flattened horns without unbrazing the bells. This is accomplished by a series of cylinders or rather portions of cylinders, balls, washers and odd-shaped pieces of metal of graduated size which are introduced into the bell, tube or slide. All sizes are provided so that no tube is too small; special hammers do the rest after the balls are wedged in and dents are thus perfectly obliterated. One of our engravings shows a rather full outfit of tools for this purpose. Of course valves become worn, leaky and otherwise out of order and here other specialists are called in; a man who works on piston valves rarely repairs circular valves and vice versa. The wood-wind shop adjoins and is not as picturesque as is the brass shop, neither is the string shop, but the results obtained in the latter are most extraordinary of all. A violin, a viola, a violoncello or a double-bass is sometimes put out of commission by an accident such as an automobile running over it. Almost any virtuoso will tell you that his instrument was improved in tone after a bad smash-up and subsequent repair. We do not believe that is true, as a rule, but there are cases which certainly go to prove it.

There are certain technical terms, as the back, belly and sides, to be considered, for the violin contains in its interior a mass of air which is let out by the *f-f* holes. There is also the neck, scroll, the bridge, the pegs and the strings, and, last but not least, the varnish which plays such an important part in the tone. If a bridge, tailpiece, or the neck and scroll are destroyed it is an easy matter to replace them; but not so the back, belly and sides, which are made of seasoned wood sometimes hundreds of years old. The tools of the violin maker are peculiar and consist of those which would be found in any cabinetmaker's shop, plus iron clamps, scrapers, oval planes (often of minute size as planes go), calipers, purfling gages, chisels and many other special tools.

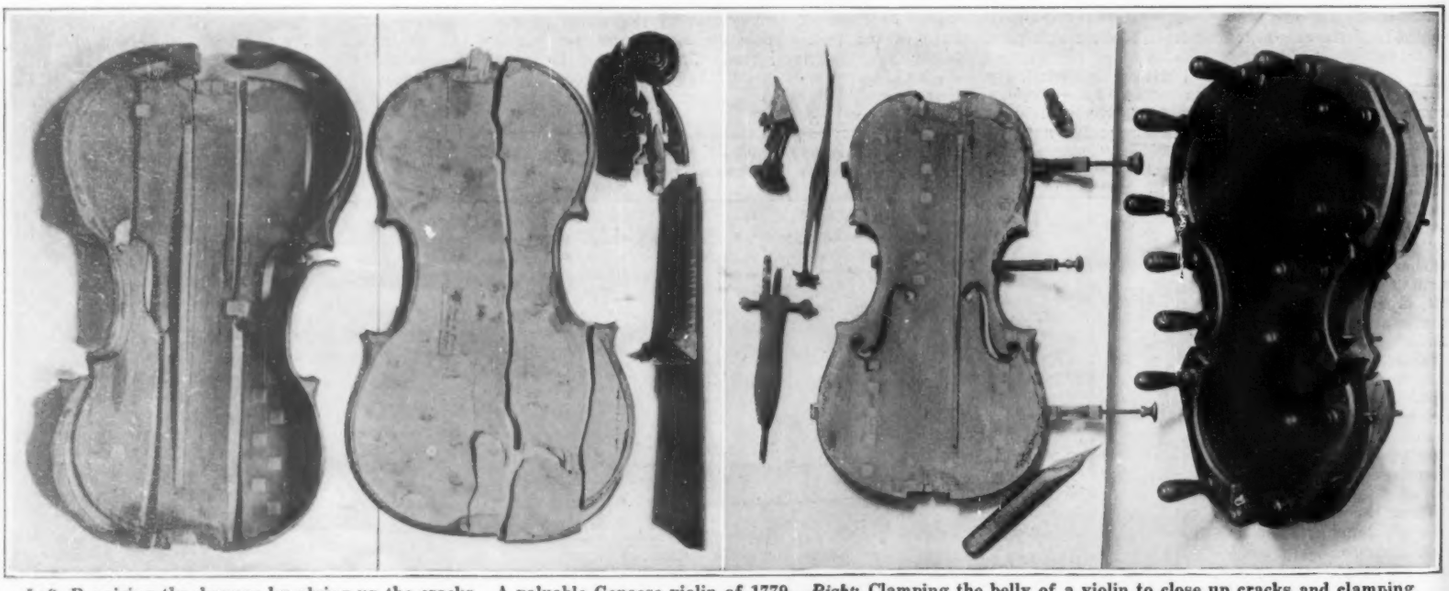
(*Continued on page 280*)



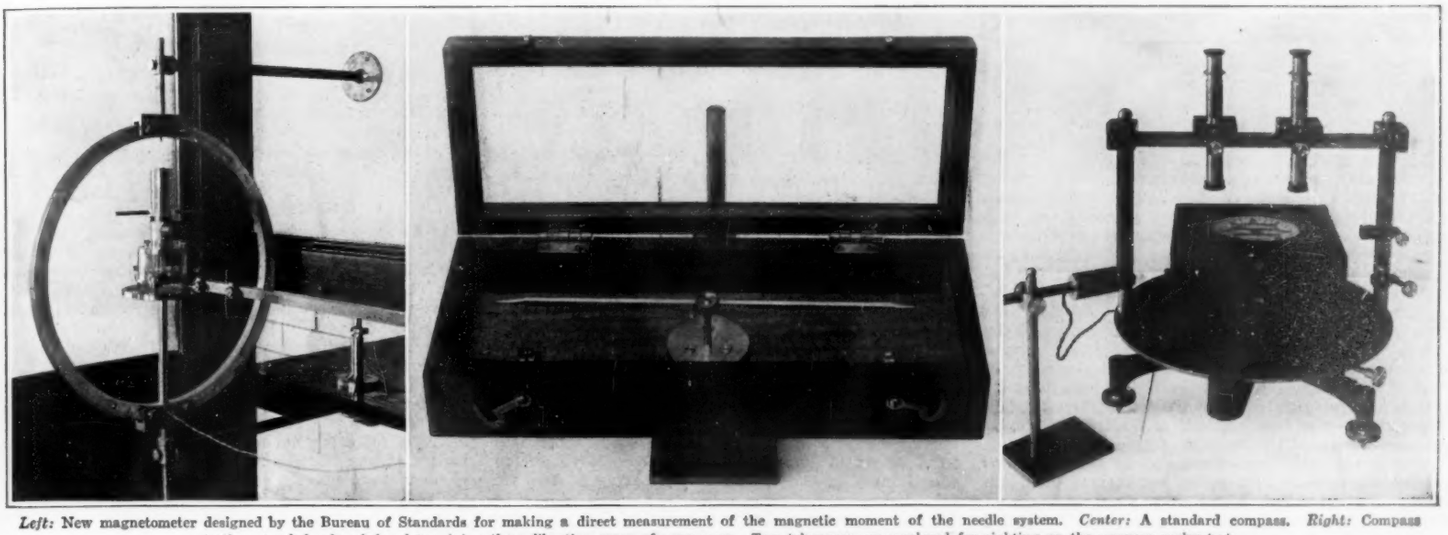
Repairing brass musical instruments. Taking out dents and polishing band horns



Tools for taking out dents in brass musical instruments. The balls are in successive sizes and are introduced into the bells and tubes and the dents hammered out



Left. **Repairing the damage by gluing up the cracks. A valuable Genoese violin of 1779.** ***Right:*** **Clamping the belly of a violin to close up cracks and clamping the glued sides to the back and belly**



Left: New magnetometer designed by the Bureau of Standards for making a direct measurement of the magnetic moment of the needle system. *Center:* A standard compass. *Right:* Compass testing stand developed for determining the calibration error of compasses. Two telescopes are employed for sighting on the compass under test

Some of the equipment used by the Bureau of Standards in testing magnetic compasses

Testing Magnetic Compasses

ALTHOUGH the subject of testing magnetic compasses was first broached by the National Bureau of Standards under the exigencies of war, complying with requests from the War Department and the United States Shipping Board, the investigations reveal information no less applicable in peace than in the days of human wreckage. The studies involving the construction of special testing apparatus, observations as to the behavior of varying types of instruments, and the performances of individual compasses, are accentuated by reason of the dearth of scientific data relating to magnetic compasses previous to these experiments.

Of outstanding interest, perhaps, in connection with the testing of compasses is the designing and installation by the Bureau of Standards of special equipment—a magnetometer for making a direct measurement of the magnetic moment of the needle system. R. L. Sanford, a physicist of the Bureau of Standards, technically describes the apparatus as a suspended system which carries besides the needle a concave mirror and an aluminum vane which swings in an enclosed chamber and serves to dampen the oscillations and bring the system quickly to rest. A permanent magnet, adjustable in position by means of which orientation and sensitivity of the suspended needle can be controlled, is mounted on the instrument. When the control magnet is so stationed that the needle assumes an east-west position, it is possible to determine the magnetic moment to a degree of accuracy approximating five per cent without arresting the compass card. The latter is difficult of attainment in liquid-filled compasses. The magnetometer is mounted, with the suspended needle at the center of a large coil of known constants, thus facilitating calibration. A support is a fixture of the instrument for holding permanent bar magnets, used for compensating or adjusting compasses.

The presence of magnetic disturbances somewhat hampered the tests at the Bureau of Standards, a factor responsible for accuracy not in excess of five per cent. Pivot friction, calibration, period, and damping are the characteristics around which the testing of magnetic compasses revolves. Excessive pivot friction may result either from injury or imperfect materials, or from shabby workmanship. Sensitiveness to slight changes of direction is the object sought by the pivot friction test. The method of test consists of deflecting the compass by a small specified angle, and determining the difference in reading before and after the deflection. The test is repeated, the compass bowl being oriented in varying directions.

A simple testing stand, as illustrated by one of the photographs, was constructed for determining the calibration error of compasses. The table can be rotated about a vertical axis, graduated around its circumference so that any angle which it may be turned can be read by means of an adjustable index. The use of a vernier insures the reading of angles to 0.1°. Two telescopes, stationed on uprights, are employed for sighting on the compass under test. A small coil is used for deflecting the compass while testing pivot friction, period, and damping. Compasses having vertical cards, when tested, necessitate a modification of the sighting arrangement. When testing for calibration, the compass is placed on this stand and the telescopes focused on the north and south points of the card. Forthwith the compass being tested is removed to a distance and the standard compass is given a berth on the stand. It is raised or lowered by negotiation of an adjustable stand till the index line is in focus. The telescopes are free from molestation after the initial adjustment. The table is oriented so that the image of the index line on the standard compass is in unison with the cross hairs of the telescopes. The adjustable index is set to zero and clamped. Once the table index has been adjusted by means of the standard compass the instrument to be tested is replaced on the stand and the error on the north heading determined by noting the difference between the compass reading and the index reading. The calibration error is the difference between the reading of the compass and the correct reading on any heading.

The so-called "period" or time of oscillation of a compass depends upon the moment of inertia of the card, the magnetic moments of the needles, and the horizontal intensity of the magnetic field. The test is made by a stop watch and auxiliary magnet or coil to start the compass swinging. The card is set swinging and the time observed for the half period or the complete period, as specifications may indicate. The period is taken as twice the time which elapses between successive transits of the card in opposite directions through its position of equilibrium when released from an initial deflection of 45°. The method of determining the damping of a marine compass is to find the ratio of two successive swings on the same side of the equilibrium.

U. S. Submarine "L-1" partly submerged and being towed to a repair station

A New American Clay for Loading Paper

A HIGHLY colloidal clay which exists in large deposits in the intermountain regions of the United States has been found by the United States Forest Products Laboratory to be valuable as a loading material for giving finish and printing qualities to book paper. When this clay is used in conjunction with English china clay, the retention of the English clay is materially increased, and the paper produced has a superior finish and appearance, and a more velvety feel. The admixture of this clay similarly improves the retention of other fillers, and is especially desirable with some which have a low retention.

The ability of the new clay to remain in suspension may make feasible the installation in paper mills of a central mixing plant, from which the loading material can be piped a considerable distance to the beaters, without danger of setting or clogging of the pipe lines, and with the assurance that the concentration will remain uniform. The properties and use of the new loading material are more fully described in a report which may be obtained from the laboratory on request.

A Submarine in Trouble

SUBMARINES, like all other ships of the sea, have their troubles; indeed, some people are inclined to think that they have more than their share. But we must remember that, in the very nature of things, the handling of a submarine is a far more difficult matter than the control and navigation of ships at the surface. Beautiful invention though the periscope is, the view which is obtained is not so complete as that of the captain on the bridge, and a search of the records will probably show that most injuries to submarines by collision have occurred when these little craft were submerged.

The accompanying photograph shows what happened to "L-1" when she was cruising off the Delaware capes, where she was rammed by the steam pilot boat "Philadelphia" and her hull was breached. Now, the perforation of her hull is a very serious matter for a submarine, if only for the reason that her reserve buoyancy is comparatively limited and any considerable inrush of water is sure to prove more than her pumps or other water-expelling means can take care of. In this particular case, the boat was saved by her commander running her on the beach in the inner harbor of the Delaware breakwater. The view which we present is taken looking aft, and the submergence of the after portion of the boat is due to the fact that her engine room is flooded with several feet of water. Fortunately, none of the crew was injured, and at the time that our photograph was taken members of the crew are on deck and the rescue boats are towing the submarine to a repair station.

The Heavens in April, 1921

The Tidal Friction and the Toll It Takes

By Professor Henry Norris Russell, Ph.D.

THERE is always something satisfactory about the "cleaning up" of a scientific problem—the leaving of it in such a well-ordered state that we may feel that, for the present, nothing more need be said; and such an outcome is the more pleasing when the problem has long been outstanding and has almost been given up as insoluble.

A very beautiful example of such success is afforded by the old question of the influence of tidal friction upon the rotation of the earth and the motion of the moon. Known in its main outlines for more than a century, this problem has remained perplexing until within the past few years, when it has been "cleaned up" in admirable style by the activity of three English astronomers—Dr. Fotheringham of Oxford, Dr. Taylor of Cambridge, and Dr. Jeffreys of Manchester.

The matter has been mentioned in these columns more than once in past years, but it may be worth while to go over it briefly again. From the days of Halley it has been known that the moon is moving around the heavens at a slightly more rapid rate now than in the days of Greece and Rome. There are a good many ancient records of eclipses of the sun and moon; and upon comparing these observations with the positions calculated by reckoning backward with the present rates of motion (which are very accurately determined), we find discordances which can be explained only by a slow, steady change in the rate of the moon's motion.

More than a century ago Laplace provided the first explanation of this singular fact, showing that the slow change in the shape of the earth's orbit, due to the attractions of the planets, would cause changes in the sun's attraction on the moon, and produce a gradual, though very slow, acceleration of its motion. At first it seemed as though this would completely account for the facts; but later calculations (which demand extreme labor and skill) showed clearly that only a part of the observed change could be explained in this way. There remained an apparent increase in the moon's rate of motion, which could reasonably be explained only as arising actually from a gradual slowing of the earth's rotation. The days being longer, the moon seems to go farther in a day.

Now there is a real and obvious cause at work which might produce such an effect—the friction of the tides as they rise and fall in the oceans and on the coasts of the world. This friction is steadily converting energy into the form of heat, and it is therefore certain that it must gradually slow down the motion from which it abstracts the energy—the rotation of the earth. The theory of this tidal friction was thoroughly worked out by Sir George Darwin, who showed that as the earth came to rotate more and more slowly, the moon must inevitably be driven, by the same tidal forces, into an ever larger and larger orbit, and that the length of the month must in this way increase.

Under existing conditions, a simple calculation shows that the length of the day must be increasing at a greater proportional rate than that of the month, so that the number of days in a month diminishes, though, measured by an unvarying standard, both are longer than before.

Days and Months

Two outstanding questions, however, remained very difficult to answer: First, at what rate the day is growing longer; and second, whether the actual friction of the tides is competent to produce an observable effect. The only way to answer the first question is by a study of the ancient records of eclipses and other observations of the moon. Dr. Cowell, of Greenwich, from such a study, concluded a dozen or more years ago that the sun, too, appears to be slowly accelerating its daily motion—as it ought to do if the days are growing longer while the years are not. But a complete discussion of the available records of antiquity was left to Dr. Fotheringham. It was a very difficult work, demanding a thorough knowledge of classical literature and archaeology, in order to interpret correctly the fragmentary and confused records which are all that remain to us; and at the same time a mastery of the intricate calculations which are always required in following the motions of the moon. But in a series of masterly papers the whole of the existing material was handled, with the very satisfactory result that all the various sorts of records—eclipses of the sun and of the moon, observations of the position of the moon with respect to the stars, and so on—could be satisfied, within reasonable limits of error, on the assumption that the sun moved 2″ farther eastward in the heavens every century than in the century preceding, while the similar excess of motion in the case of the moon was 21″. About 13″ of the latter is known to be due to the changes in the earth's orbit, leaving 8″ for the tidal influence.

The accordance of the results derived independently from the various sorts of ancient observations is sufficiently good to make it practically certain that the earth is rotating more slowly than it did two thousand years ago, and that, at the end of each century, a day is longer by a little less than 1/800 of a second of time than it was at the beginning of the century. This will explain directly the apparent acceleration of the sun, and, when allowance is made for the change in the real length of the moon, will account for the behavior of the moon, too.

Hence, from the observational side, the problem appears to be well cleared up. But the theoretical implications of this minute change in the length of the day are startling. The earth is so massive, and its rotation so rapid—a point on the equator moving at more than a thousand miles per hour—that even a very small change demands an enormous alteration in its energy. A straightforward calculation, though one involving the use of very large numbers, shows that to lengthen the day by 1/800 of a second in a century demands the abstraction of energy from the earth's rotation at a rate corresponding to the action of about two and one-half billion horsepower continuously during the whole time! Until within the past few years, it seemed very doubtful that the friction of the tides could be great enough to account for so huge an amount.

Horsepower by the Billions

In the deep sea, where the water rises and falls but a few feet, and the currents are slow, there is very litttle friction; but near the coast, where powerful currents run in shallow water, the situation is different. There are few parts of the sea where the depths, tides and currents are well enough known to permit of even a roughly accurate calculation. But Dr. Taylor, taking the comparatively complete data for the Irish Sea, showed that in that small area alone the tidal currents dissipated energy enough to account for about two per cent of the whole amount demanded by theory. Dr. Jeffreys, following his lead, has collected such information as was available about the tides and currents in shallow seas, all over the world; and has calculated the rate of dissipation of energy into heat by the friction. His results are altogether remarkable.

High tides, of course, go with strong friction; but even more important are strong currents over large areas of fairly shallow water (fifty fathoms or less). The enormous tides of the Bay of Fundy, for example, use up on the average about 60 million horsepower. The tides in the channels between the Arctic islands west of Greenland, which rise fairly high and are accompanied by very strong currents, appear to do about four times as much work; so that some 300,000,000 horsepower is accounted for on the American side of the North Atlantic. On the European side the total effect of tidal friction appears to be about as great, being localized mainly in the narrow seas which surround and separate the British Isles.

The South Atlantic and Indian Oceans contribute relatively little, since there are few shallow bays or gulfs along their shores. Along the east coast of Asia, however, there are great areas of shallow water; and these, from Malacca Strait to the Sea of Okhotsk, contribute altogether some 450 million horsepower.

By far the most remarkable region in the world, however, is Bering Sea, where tidal currents of unusual strength sweep in and out over very large areas of shallow water. The existing information is scanty, but enough to show pretty plainly that there is more tidal friction in these waters than in all the Seven Seas besides. Dr. Jeffreys' estimate of the work of friction here is two billion horsepower, making a total for the world at large of three billion horsepower, in round numbers. This is substantially equal to the amount required to explain the observed changes in the apparent motions of the sun and the moon. The agreement of the two figures is all that could be hoped for in view of the incompleteness of the tidal data.

One or two incidental researches are of interest. The real length of the sidereal month is increasing each century by about 1/46 of a second of time. But since we compute it with the actual day, and not with a day measured by an absolutely uniform time-piece, and since, at the end of a century, 27⅓ days have grown longer by 1/30 of a second, the month appears to us to be shortening by about 1/85 of a second per century. To the increase in the real length of the month corresponds an increase in the moon's average distance from the earth—at the rate of 7½ feet per century! Minute as this appears, the rate at which work is done in pulling the moon away against the earth's attraction is equivalent to nearly 100,000,000 horsepower acting continuously.

The Heavens

Turning from these recondite matters to the familiar face of the starry skies, our map shows us that, at our chosen hour of gazing, we shall find the Great Bear almost overhead, but a little north of the zenith. The line of the pointers leads us down to the Pole Star, and past it to Cassiopeia and Cepheus, low in the north.

(*Continued on page 280*)

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

At 9¼ o'clock: April 30.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

Optical Tricks with Electric Sparks

By W. A. Kimball

THE number of alternations, per unit of time, of an electric spark jumping between the terminals of a spark gap can be determined by proper apparatus in cases where the alternations are too rapid to be detected by the eye, if the apparatus can be made to send to the eye reflections that have frequencies slow enough to be received by the eye. Applying this principle the writer constructed apparatus as follows:

From heavy cardboard, one side of which must be black, cut a circular disk 45 centimeters in diameter. From white paper cut circular disks 4.5 centimeters in diameter. Arrange a row of 17 white disks equi-distant apart on outer section of large black disk. Arrange a second row of white disks inside first, eleven in number. The third row of white disks, five in number, will occupy remaining section of large black disk. Care should be taken to place the three rows of white disks equidistant from each other as well as to have the white disks of each row equally spaced.

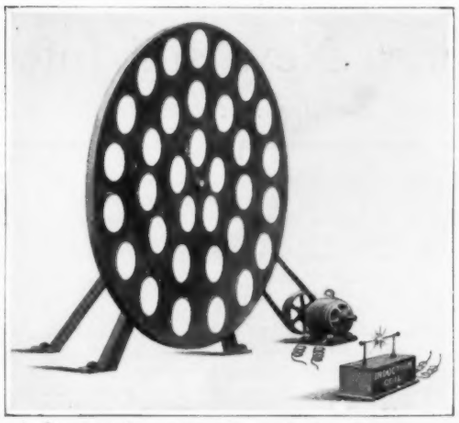
One could substitute for the above a circular cut wooden disk, painted black and when dry painting smaller white circular disks on the black background.

If the class room or demonstration room is first carefully darkened and the large disk is placed on a rotating machine and rotated at varying speeds in front of an electric spark of sufficient size to illuminate the entire disk, many interesting results can be obtained.

By regulating the alternations of the spark and speed of rotation of the disk you will observe that a certain speed of disk will cause one of the rows of white spots to appear to remain stationary while the other rows are moving. Again, if the operator should increase the speed of the disk he can make the row which previously seemed stationary move forward in the same direction as the rotation of the disk. By decreasing the speed of rotation this row of white spots will move in the opposite direction. While one row at a certain speed appears to move in one direction another row will appear to move in the opposite direction and the third row may appear stationary.

The effects that can be produced are interesting and varied and the principles involved are useful in explaining to a group of students the reasons for different effects produced by moving pictures. It is easy to explain clearly why carriage wheels in motion pictures appear to be rotating backward at certain times and forward at other times during the same picture.

The size of the large disk and number of spots in each row is of course optional. The larger the disk and the greater number of white spots and rows, the more varied the results and the more interesting.



A home-made apparatus used for class-room demonstration of the frequency of an electric spark

Reclamation Project in Northeastern Brazil

THE Diario Official of October 30 contained decrees approving the contracts by the Inspectoria de Obras Contra as Seccas with two English and one American firms for the administration of the construction of dams, irrigation canals, and other work judged necessary for the execution of the reclamation project. These firms will act as Government agents, purchases being made for the account of the Inspectoria. Equipment will be purchased, when necessary, by opening credits in New York. It is planned to begin construction as soon as equipment and men can be brought on the ground. Government funds for the completion of the project have been arranged. At the present time the Federal Government has 40,000 contos cash allotted to reclamation work, and the remainder of the 200,000 contos appropriated will be raised by a 2 per cent tax on Brazil's gross revenue, which it is estimated will bring another 40,000 contos per year; thus the total amount will be available in four or five years.

Tylosaurus in life, as reconstructed by the Smithsonian scientists

An Extinct Sea Lizard from Western Kansas

By Charles W. Gilmore

THE chalk deposits of western Kansas have long been famous on account of the great number and the fine state of preservation of the fossil remains found in them. For more than fifty years collectors of fossils have searched the chalk exposures for their hidden treasures. Remains of fish, large and small, turtles, toothed birds, lizards, both swimming and flying, and an occasional dinosaurian reptile have been the rewards of these indefatigable hunters.

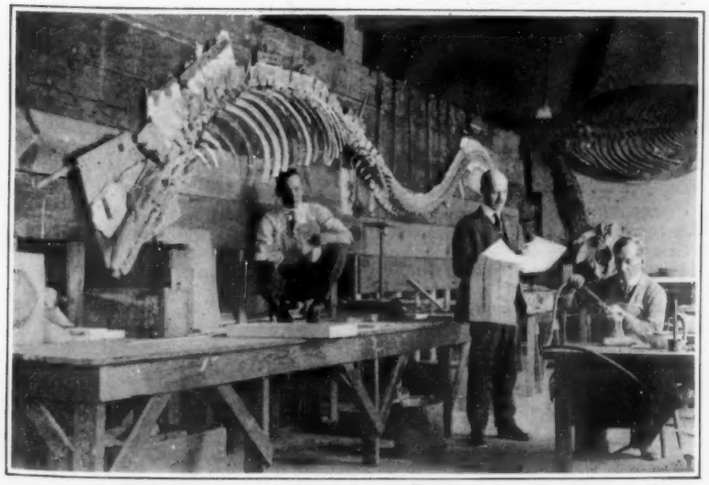
The United States National Museum numbers among its rarest treasures fossil remains of all of these several kinds of animals, but quite recently there has been added to the exhibition series the very fine specimen of a swimming or sea lizard shown in the accompanying illustration. This animal goes under the name of *Tylosaurus proriger*, and belongs to a group of extinct reptiles commonly called Mosasaurs. The mosasaurs were water living reptiles, with long slender bodies having the limbs modified into short swimming paddles, and a long powerful compressed tail with which they propelled themselves through the water. This specimen, after many weeks of the most painstaking care and skilful work, was cleaned from the investing chalk, the broken parts repaired and the missing bones restored, until finally the skeleton was articulated in the pose shown. It forms a wall panel, the skeleton being in half relief, the dark bone of the specimen standing out in bold contrast against the light yellowish color of the background, which has been made in imitation of the yellow chalk in which the specimen was originally found. The pose adopted for the skeleton was largely determined by the curved articulated sections of the backbone as found in the ground.

This specimen was collected for the National Museum by the veteran collector of fossils, Mr. Charles H. Sternberg, on Butte Creek, Logan County, Kansas, in 1917. Mr. Sternberg and his three sons, all of whom have been raised as fossil hunters, have collected hundreds of these ancient monsters and the results of their discoveries are to be found in all of the principal museums of the world, the present specimen being still another contribution to the science to which they have given so much.

The *Tylosaurus* specimen, as now exhibited, measures about twenty-five feet in length, with a head that is three and one-half feet long. The largest of the Mosasaurs, however, sometimes attained a length of forty feet, and such an animal would have a head fully five feet long. Some of the small adult species were scarcely more than eight feet in length.

The seas that rolled over Kansas in Cretaceous times contained thousands of these animals, and in the chalk bluffs of that region their remains are in such a perfect state of preservation that we are not only acquainted with their skeletal structure but with their external appearance as well. Impressions made by the body in these soft sediments before decomposition had set in have been found, showing that in life they were covered with small overlapping scales. In fact, small areas of skin impressions were found with the *Tylosaurus* specimen here discussed. The most unusual discovery relating to the appearance in life of an animal long extinct, was the detection of color markings by

(*Continued on page 280*)



Skeleton of the fossil sea lizard being mounted for exhibition in the National Museum

Upper jaw, with teeth, of a Mosasaur from Alabama, a fairly close relative of the Kansas lizard

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

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Using the bayonet and scabbard to split wood for the small stove

A New Role for the Bayonet

INGENIOUS minds in Europe have been working overtime ever since the armistice was signed and hostilities ceased, developing all manner of peaceful uses for military equipment. Many of these innovations and adaptations have been shown in these columns, and we have the bayonet wood-splitter to add to our published collection. This device consists of the standard bayonet scabbard, the bayonet, and two members which hold the bayonet and scabbard together and permit of mounting them on a wall, all as shown in the accompanying illustration. A number of notches cut in the front end of the scabbard permit of holding a piece of wood of any length in place while the bayonet does the splitting.

The Parachute Turned Toy

WITHIN the past month or two a new craze has sprung up in the ranks of Young America, namely, tiny parachutes which afford no end of amusement. While there are several different makes of these diminutive parachutes on the market, the best one is made of a light silk-like paper of extreme toughness. It appears that these parachutes were used by United States Army aviators for sending down messages while in flight, and consequently manufactured in very large numbers. Some enterprising person, knowing something about American boys and girls, undertook to dispose of the surplus paper parachutes to the toy stores. From the very first the parachutes have taken the youngsters by storm.

Waiting for a passing subway train to send a blast up through the grating for the toy parachute

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WHEN any part of a machine is to be repaired, the usual manner of mending that part is to take down the machine and reassemble it after the repair has been effected. Today, in many cases, machines do not have to be taken down and much time lost, especially when the repair is nothing more serious than placing a new washer on a shaft. This saving in time and effort is brought about by a special washer which opens up so that it can be slipped over a shaft. There are two designs of this washer, namely, one with a steel side-latch, and the other with a brass over-latch. Latch and riveted parts are machine cut, which makes for a perfect fit. The washer is closed by means of a light blow with a hammer, or by using a hammer and punch on the top of the over-latch.

A washer that can be opened and placed without the necessity of taking down a shaft

Trucks for Gas Rescue Service Work

WHAT is claimed to be one of the best examples of standardized equipment in the service of a public service corporation is the fleet of light trucks for emergency work that has been installed by the Gas Company that serves Boston and a number of the surrounding municipalities. The company has an emergency department that is as well organized as the fire department of any large city. It is expected to safeguard the citizens against asphyxiation, explosions and the dangers that may develop from fire, and any of the crews must be ready to instantly respond to any form of call by day or night.

The department consists of 15 crews of three men each, which are stationed in as many different sections of the city, as near the centers of the districts as is practically possible. Each crew is provided with its own truck and responds to all alarms of fire in its district. In addition, it may be ordered to reinforce another crew in the event of conditions that one crew cannot cope with such as a large fire, an explosion, or similar disaster, prepared to shut off the gas supplies of buildings or areas, to resuscitate those who may be suffering from the effect of gas inhalation and each crew is subject to call for every gas leak of consequence in the district.

The crews have fast, light trucks equipped with special bodies, these having been designed for the special needs of the service. Each truck carries a pulmotor for resuscitation of persons suffering from inhalation of smoke or gas, two gas masks for working in dense gas, smoke or even ammonia fumes; every tool needed for emergency work on gas pipes and mains, including wrenches, bars, hammers, etc.; two fire extinguishers, a ladder for descending into cellars, manholes and the like; ropes, chains, cable, rubber boots and coats and a first aid kit. In addition there are electric torches and such materials as are necessary for making temporary repairs for practically any kind of a gas leak. The equipment is stored in compartments which are quickly accessible and every part of the body is devoted to storage of useful apparatus and equipment.

A Revolving Stand for the Christmas Tree

NOT satisfied with the plain wooden and metal stands used with Christmas trees, an American inventor has developed the rather elaborate stand shown in the accompanying illustration. The box contains an electric motor, which turns the shaft that carries the socket at the top of the box. The electric light connection is made by means of a plug and connecting cord leading to the box, and coming out of the motor-driven shaft is a short connecting cord and socket, in which the plug from the Christmas tree lights may be plugged. In this manner the electric lights are operated while the tree is turning without interference or interruption of any kind.

A Christmas tree stand that revolves the tree while the lights are on

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A camera which takes direct positive pictures on perforated strips of bromotype paper

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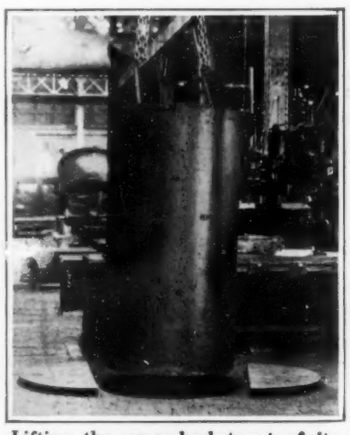

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It is indeed a pleasure to have business relations with a concern that chooses such a policy, as you have shown to us in this instance.
Again thanking you most cordially, we are
Yours very truly,
SOUTHERN OIL & FEED MILLS, INC.
BY:(Signed)
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Los Angeles, Ca.

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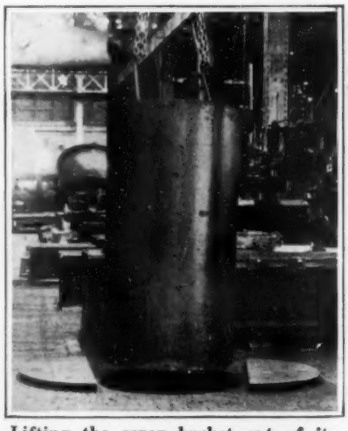

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165 Broadway,
New York City.
April 23,1920.
Gentlemen:
Attention Chief Engineer
We wish to thank you, and to say that we appreciate highly your sending ******** here to assist us with the trouble we were having with ball bearings in our mill. Mr. ********, we believe, has made us some very valuable suggestions, and we believe, his visit to us is going to prove most profitable. We wish also to thank you for your promptness in forwarding the two 6316 bearings, which came in very promptly.
It is indeed a pleasure to have business relations with a concern that chooses such a policy, as you have shown to us in this instance.
Again thanking you most cordially, we are
Yours very truly,
SOUTHERN OIL & FEED MILLS, INC.
BY:(Signed)

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Double row self-aligning ball bearings. Transmission equipment.

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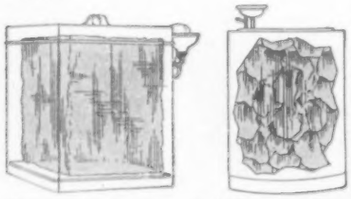
WATER spurts from the bubbler on the Jewett in a diagonal stream and it is impossible for anyone to drink directly over the bubbler. The lips cannot touch the bubbler nor can any water drop from the mouth back into it and cause contamination. It eliminates the germ spreading tin cups, dipper or glass, also the expense of paper cups. Yet a glass can be easily filled from this angle-flow stream.

The ice in the Jewett does not come in direct contact with the water. It merely chills the coils through which the water flows. This precludes any chance of impurities in the ice getting into the water and insures just the right temperature—ice cooled water, not ice water that induces stomach disorders. You safeguard your employees' health when you install Jewett Water Coolers.

Selling Direct Cuts Costs

Jewett Water Coolers are sold direct to you from our factory. That means an appreciable saving on initial cost. Any handy man can attach it to your regular water supply.

The Jewett helps ward off the tiring, production-retarding effect of sweltering weather. A post card mailed today will bring complete information on the Jewett Water Coolers.



Economy in ice consumption is another outstanding feature of the Jewett. Notice the square design. It takes ice in a solid cake. Ice has to be broken up before the ordinary round type cooler can be packed. This means extra labor and waste, for cracked ice melts more rapidly than ice in a solid cake.

Size No. 1, $58 50 lbs. Capacity
Size No. 2, $75 100 lbs. Capacity

The Jewett Refrigerator Company
Established 1849
24 Chandler Street Buffalo, N. Y.

JEWETT
SQUARE WATER COOLER

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRSHIP.—K. A. ENLIND, c/o Greeley Chemical Co., 2126 Broadway, New York, N. Y. An object of this invention is to provide an airship, the construction of which will reduce the number of essential parts and will increase its strength and durability. More especially the invention proposes an airship having rigid envelops or gas tanks certain of which are rotatable and provided with means so that upon their rotation they serve to drive the ship through the air, and to use propellers having the function also of sustaining the ship in the air.

PROPELLER.—B. B. WOOD, Box 738, Minneapolis, Minn. The invention relates particularly to airplane propellers, the purpose being to provide an air propeller having the desirable features of simplicity, durability and efficiency, and a propeller which is so constructed as to produce a forward thrust of great intensity to airplanes or other vehicles.

Pertaining to Apparel

GARMENT.—K. HEITLER, 605 W. 141st St., New York, N. Y. The invention relates to a garment in which no draw-strings or other encumbering device will be necessary at the waist portion. The garment includes a body portion of elastic material, said body portion presenting an uninterrupted waist opening, an elastic band in intimate contact with said body portion, and attached to one of its faces and adjacent said waist opening.

Electrical Devices

ELECTRIC HAIR SINGER.—J. P. MCMAHON, 15 11th St., Whitestone, L. I., N. Y. The object of the invention is to provide a hair singer using an electrically heated wire as the singeing medium to insure a quick and effective singeing of the hair. Another object is to provide a simple construction and arrangement to prevent short circuiting through the medium of the hair or scalp.

DRY BATTERY.—B. H. TEITELBAUM, address Bright Star Battery Co., 310 Hudson St., New York, N. Y. The invention has reference more particularly to a dry battery having zinc chloride as an ingredient in the electrolyte, also being provided with a valve arranged to allow the escape of the ammonia formed as the battery is used, but to exclude the air from said battery.

Of Interest to Farmers

ANIMAL POKE.—H. GERDES, Benkelman, Neb. An object of the invention is the provision of a poke of simple and efficient construction which is formed with spurs mounted to automatically engage the neck of an animal

SHOWING THE INVENTION AS APPLIED

when he attempts to force his way through a fence; by means of a lever the spurs are so held that they will not engage the neck of the animal under normal conditions.

HITCH FOR TRACTORS.—G. H. SCANLAN, 202 Fulton St., New York, N. Y. The invention relates to a hitch which will properly hold one or more implements in position to be moved by a tractor. An object is to provide a hitch which is especially designed for connecting plows to the tractor, the construction being such that a ready adjustment may be secured for causing the plow to assume various depths while a proper strain is brought to bear thereon continuously.

Of General Interest

COMBINATION STEEPER AND DIPPER.—G. H. NICHOLLS, Box 536, Beaumont, Texas. The invention has for its object to provide a steeper and dipper adapted for use in making tea or coffee, wherein a perforated container is provided which is slidably connected with the pot at the axis thereof to move vertically to permit the tea or coffee to be supported in the water in the pot or out of the water.

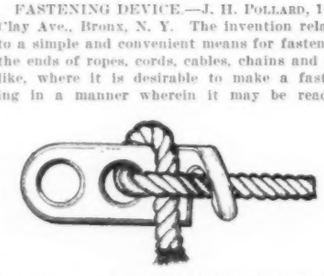
SAFETY RAZOR.—A. C. KNUDTSON, 920 Ave. B, Bismarck, N. D. The invention relates to a safety razor comprising a relatively flat separable holder for a removable blade, and a rectilinear handle separate from the holder, and serving to secure the same in clamping relation to the blade, and in which displacement of the blade and clogging up of the holder and guard is positively prevented.

INSULATING MATERIAL OR CONSTRUCTION.—A. WORTHINGTON, 322 E. 28th St., Brooklyn, N. Y. Among the objects of the invention is to provide an insulating material, for use in connection with steam boilers or other analogous appliances, of maximum cheapness as well as efficiency, considering the strength or power to resist crushing strains or blows. A further object is to provide an insulating material embodying a maximum number of air cells with respect to the body of the structure tending to resist crushing.

FISHING NET.—A. WOLF, 251 8th Ave., Long Island City, N. Y. The invention has particular reference to hand-operated devices in the form of nets commonly employed for crabbing or landing fish that are caught on hooks. Among the objects is to provide a fishing net having a practically rigid frame adapted to be disconnected from the handle and folded so as to occupy a small amount of space.

Hardware and Tools

FASTENING DEVICE.—J. H. POLLARD, 1183 Clay Ave., Bronx, N. Y. The invention relates to a simple and convenient means for fastening the ends of ropes, cords, cables, chains and the like, where it is desirable to make a fastening in a manner wherein it may be readily



A PLAN VIEW, SHOWING MANNER OF FASTENING A ROPE

detached without the inconvenience of untying the knot. A feature of the device is the various instances where it can be advantageously used, and the low cost of manufacture.

ADJUSTABLE TUMBLER LOCK. — F. CLARK, c/o R. A. Day & Co., Apartado 91 Bis, Mexico City, Mexico. Among the objects of the invention is to so construct a lock of the combination type that it will easily get out of order, and to provide a lock of simple construction, having few parts, compactly arranged, and which may be inexpensive to manufacture. A further object is to provide a lock which may be actuated by the mere insertion of a key.

Heating and Lighting

AUTOMATIC WATER HEATER.—G. S. WALKER, 325 Atwood St., Pittsburg, Pa. The object of this invention is to provide a water heater whose automatic action is dependent upon the differential action of two thermostats, with the intent of eliminating the piston water valve which it is the custom to use in heaters of this type, but which frequently stick and cause accidents or put the heater out of commission. A further object is to eliminate stuffing boxes, glands, etc., and to provide a heater which is simple, safe, and economical in the consumption of gas.

Machines and Mechanical Devices

CORING MEANS FOR TOMATO PEELING MACHINES.—C. KIRINO, P. O. Box 418, Ogden, Utah. The invention relates to means for coring the tomatoes after the skins are removed. The general object is to effect the step of coring the tomatoes by means embodied in the holders on which the tomatoes are impaled and carried about the machine, said means being arranged to be operated by conecting fixed means on the machine, whereby to eliminate the use of separate coring mechanism.

Medical Devices

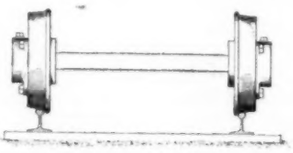
TONGUE SHIELD.—G. GUISE, Riley, Ind. The invention relates to a tongue shield for use in taking medicine; the shield consists of a liquid-proof material, the front portion being tubular to accommodate the tongue, the top presenting an area to cover and shield the gustatory area of the tongue.

Prime Movers and Their Accessories

MOTOR.—P. C. CLARK, 446 N. 2nd St., Montrose, Colo. This invention has for its object to provide a motor operated by the flow of water for supplying a portion of said water to a reservoir or the like, wherein a rocker is provided adapted to be rocked by the flowing water, the rocker operating means for diverting the water to the opposite side of the rocker to cause the rocker to rock, the rocker being connected to a pump to operate the same when it is rocked.

Railways and Their Accessories

CAR-WHEEL AND MEANS FOR MOUNTING THE SAME.—G. E. PRATT, 621 Summit St., Pueblo, Col. The object of the invention is to construct a car-wheel and method of mounting the same to an axle which is particularly designed for use in connection with



AN AXLE AND WHEELS DESIGNED ACCORDING TO THE INVENTION

small cars, such as mining cars, but which may be readily designed so as to meet the requirements of a large type of car. A further object is the construction of an axle which will have a life equally as long as that of the car, and which will not have to be machined.

Pertaining to Recreation

GAME APPARATUS.—T. A. Y. HODGSON, Palmerton, Pa. The object of the invention is to provide a game apparatus, which includes a game board having indicated thereon the directions of movements of the different types of pieces, the indications on the game board corresponding with the indications on the different types of pieces.

Pertaining to Vehicles

TIRE RIM TOOL.—H. H. FISCHER, c/o B. F. Patschke, 7th and Guilford St., Lebanon, Pa. The invention relates to appliances for removing a split demountable rim from a tire or replacing the rim on the tire. The object is to provide a tool which is simple and durable in construction, easily placed in position and arranged to require comparatively little physical exertion on the part of the user.

TIRE DEFLATION INDICATOR.—E. O. CARVIN, Box 382, Nevada City, Cal. The object of the invention is to provide mechanism for use in connection with the tires of motor vehicles, for indicating by means of a signal when the tire is deflated beyond a predetermined point, the signal being controlled into operation by the deflation of the tire, and operated by the rotation of the wheel of the tire either in forward motion or in the reverse.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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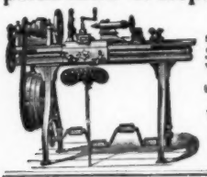

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This Weber Tool turns all pins absolutely round from one setting of Crank Shaft, on centers. A micrometer dial enables the operator to gauge his cuts and turn all pins to uniform size. The average time required for truing up one pin is from 5 to 10 minutes. The 4 pins can easily be finished in 30 minutes, and the entire shaft is completed with only one setting.

The Weber Tool is guaranteed to turn crank-pins within as close limits of accuracy as any other known method. It will soon save its cost in any Tractor or Automobile Repair Shop. An assortment of cutting tools are furnished. These will fit the pins of most of the popular automobiles, trucks and tractors. Write for Circular and Prices.

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353 S. Alameda St. Los Angeles, Cal.

Twelve Hundred Charts at a Third of a Cent

(*Continued from page 264*)

Great Britain for more than twenty-five per cent of its charts.

In November, 1914, the following notice was sent out from the British Admiralty chart agent:

"I am instructed to give notice that no supplies of Admiralty charts are to be made without authority to any European countries, or subject of these countries, with the exception of France, Russia, Greece and Portugal. Applications for charts from all other parts of the world are to be submitted for consideration. Further, no sales are to be allowed to any customer until the *bona fides* of the purchaser has been satisfactorily proved and a certificate stating the name of customer, nationality, service, and ship or shipping company, for which the charts are required, has been received."

Suppose the date to be 1921 instead of 1914. Suppose, instead of being an ally of England, England stood aloof, and sold charts neither to us nor to the Fiji Islands if we were at war with them? It will not do to say that we have copies of all charts Great Britain has issued. So we have. But we have not enough. Charts wear out quickly in use. For every ship there must be a full outfit of charts for every locality she can possibly need to visit.

From the standpoint of economy, it is far cheaper for us to reproduce a chart and sell it at cost, than to buy it from Great Britain. But this is not a matter of economy. Whether we spend a hundred thousand dollars in ten years buying charts from Great Britain for naval use or three hundred thousand in five years reproducing those charts so that we are forever independent of Great Britain—and of the items of time of transportation and time of manufacture—is not important from the dollar side. It is vitally important from the naval efficiency side.

The war taught us something of what unpreparedness meant. It gave to us all the full knowledge of how useless were guns without men, men without clothes and food, clothes and food for men abroad without ships to carry them. In any war not fought at home, the vital factor, the underlying, dominant thing by which a war is lost or won, is transportation. And transportation at sea is either a leap in the chartless dark or a reasonable hazard if the ship has the knowledge of reef, shoal, current, depth, bottom, lights, buoys, which can be obtained from charts and only from charts.

We have the most able chart makers in the world. We have a navy which is second to none in quality and second to but one in size. We have the money, the men, the will, to be invincible in defense. Are we to continue to stultify all that we are, and all that we have spent, by lack of charts? Or will we who do not go down to the sea in ships, but who have both a wholesome admiration for, and an utter reliance upon, our navy, see to it that our legislative body does not deny this necessary expansion to our naval munitions program?

When Humpty-Dumpty Travels

(*Continued from page 265*)

or a quarter-sized honeycomb for the bottom layer as a cushion. If these become only slightly damp they collapse and are useless.

The express company now requires that pads of excelsior be used on top of and beneath the half-cases of eggs as a buffer. It is recommended that a third pad be placed between the two top layers of eggs, as these are most often broken.

It is a well-known fact that even a strong man cannot crush an egg if he applies his strength evenly on the ends. But it does not take much strength to crush an egg if pressed on the side. The best of the new egg containers take advantage of this principle and the egg

"W & B" Machinists' Knife Handle Wrenches are made for heavy duty. Their strength and dependability, together with their easy-acting solid steel screw adjustment, have prompted thousands of users to specify the "W & B" brand. Fully guaranteed.

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CAUTION Insist upon having W. L. Douglas shoes. The name and price is plainly stamped on the sole. Be careful to see that it has not been changed or mutilated.

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the modern wood preservative gives new life to old or new wooden floors.

Stormtight
the protective roof coating for all kinds of worn or new roofs. Saves labor and material cost of new roofs.

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when packed is literally suspended under tension between two flexible holders which grip the ends. Thus held it is almost impossible to break the egg, short of wrecking the case itself.

But an ideal egg container must have other qualities. It must, first of all, be cheap. Many of the best containers are of very little practical value because they are of complicated structure and too expensive to manufacture. Another desirable feature which is usually overlooked by the inventor is the need for removing the eggs easily and rapidly. Where large quantities of eggs are handled this is an important factor and is one of the chief reasons for reluctance in giving up the old containers. In such operations as candling, repacking, etc., the worker simply lifts out the honeycomb and picks up the eggs. In some of the newly devised containers, it is necessary to pick up each egg individually and sometimes they are hard to grasp. Another desirable feature is that the container be able to stand more than one trip without breaking down in a vital spot. Finally, the container which confines a broken egg to its own compartment adds a point in its favor.

There is not yet on the market or, so far as the writer can ascertain, in existence, an egg container which has all of these qualities. So the "perfect" method of shipping eggs is yet to be found, but at least two of the containers now available, one of which is already on the market, seem to meet all normal requirements.

It is related that recently a carload of eggs was wrecked and an experienced freight estimator reported the probable damage to the eggs at $1,000, supposing that the standard packing methods were used. It happened that the eggs were packed in one of the new style containers and an examination of the contents of the car showed an actual damage of $19. This is not surprising when the laboratory tests of this particular container are compared with those of the honeycomb type.

Only one of the new containers has seen any wide introduction so far, but it has met with such success that experts believe the ancient prestige of the honeycomb filler has at last been seriously challenged. And one of these happy days, they believe, Mr. Ultimate Consumer will no longer have to foot million dollar bills for broken eggs.

The Why of Luminous Paints

(*Continued from page 265*)

explained here that what we really see is the phosphorescent glow of zinc sulfide (crystallized zinc) and not the radium.

Light has the effect of actually altering the structure of certain substances. That is, the cells or crystals which compose the substance are stressed by light so that they change their shape and this change sometimes changes the properties of the material. The action of the selenium cell, by means of which it is possible to transmit photographs by wire, depends upon this principle. In this case the change in the crystalline structure of the metal affects the electrical conductivity.

A similar change takes place in all of the so-called phosphorescent substances. The cells, distorted by light, have an elastic quality and when the light is removed gradually resume their normal shape, and in doing so give off light. This light gradually dies away as the crystals approach normal and the light they give, at best, lasts but an hour or two.

The curious thing is these phosphorescent substances behave in the presence of radium exactly as though they were exposed to light. The most sensitive to the presence of radium so far discovered is zinc sulfide and for this reason it is used as the base of all the commercial luminous materials.

Only a very minute quantity of radium is required. In fact, while the world production of radium is now nearly an ounce a year, only about 5 per cent of this production is used to illuminate the millions of watch and clock dials, instru-

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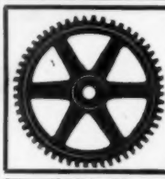

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ment dials, buttons, locators, etc. Something of the terrific power of radium can be realized from this fact.

In fact the smaller the amount of radium used to secure a given luminosity, the better the substance. For the powerful radium rays gradually destroy the structure of the zinc crystals and they lose their phosphorescent quality. The chemist's problem is to produce a phosphorescent substance which will stand up longest under the terrific bombardment of the radium rays and which, at the same time, will give off the most light. Such progress is being made in this direction that today only about one-twentieth the amount of radium used four years ago is needed in the making of luminous material. And the chemist insists that he has only scratched the surface of possibilities in this direction and that even better results can be attained. At present the life of the zinc crystals is from 15 to 20 years, although the radium lasts for centuries.

Because of the supreme importance of the zinc sulfide, it is extracted in the same factory and under the same precision control as the radium itself. It must not only be chemically pure, but the crystals must be perfectly formed. The perfect crystal is an elongated hexagon. When viewed under the microscope in the presence of radium the crystal has a slightly irregular shape and is surrounded by a sort of halo of light.

The zinc sulfide is tested for endurance by subjecting it to a high-frequency electrical current. The current is carefully gaged and by observing when the crystals break down the life of the material in years in the presence of a given quantity of radium can be accurately foretold.

This life will be much longer if the instrument to which it is applied is kept away from the light much of the time. The crystals, already stressed by the radium rays, have an additional strain imposed by the light and this hastens the process of disintegration. Strong sunlight, especially at the seashore where the presence of much ozone in the air intensifies the ultra-violet rays, has a very destructive effect on luminous material. For this reason the manufacturers of this delicate substance usually guarantee it for about half its normal life, or ten years.

Both the luminosity and the life of the substance may also be affected by the manner of application. Only the purest of adhesives are used and the luminous material, in the form of a fine yellow powder, is mixed in a little bowl in very small quantities. Care is taken in mixing not to crush the tiny crystals. The application to the object to be illuminated is made with the tip of a fine brush, the material being deposited in little drops until the surface is covered. Should the material be brushed on, the crystals would suffer and both the life and the luminosity would be lessened.

Of all manufactured substances radium luminous material is perhaps the most delicate and most sensitive.

Making the Most of Niagara

(*Continued from page 266*)

then, after reaching the crest of the structure, glide down the rear slope and back into the sweep of the river. The descending ramp will prevent the ice from dropping sheer on to the riverbed and thus obviate any undermining of the dam. Further, the modeling of the dam is one that can be counted upon to make an ice jam well-nigh impossible.

The dam will serve the double purpose of impounding the waters of the Niagara for a distance of nearly 5 miles and of housing the great turbo-generators that will transform the force of those waters into 2,000,000 horsepower of electrical energy. According to the estimates, this undertaking would involve a total outlay of approximately $100,000,000; and from start to finish would take something like three years. On the basis of coal consumption previously cited for the devel-

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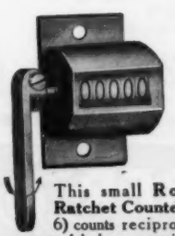

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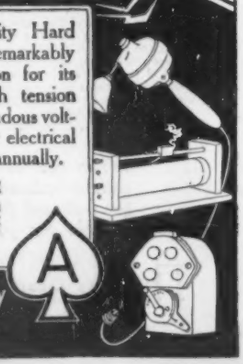

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opment of a horsepower year, *i.e.*, 8 tons, this scheme would be tantamount to saving 16,000,000 tons of that fuel annually. At $10 a ton this would represent an economy of $160,000,000 every twelvemonth. But quite apart from these considerations, there would be that inestimable gain in the matter of electrical energy that could be utilized for innumerable industrial purposes. Not only that, motive impulse at a moderate cost would be available for domestic services of many sorts.

We have led the world in the varied character and the magnitude of our electrochemical industries, and we can maintain our position in this respect only by continuing to provide great blocks of low-priced current to meet the increasing demands for the commodities now manufactured at or near Niagara Falls. Finally, let it be recalled that the two projects might prove exceedingly valuable sources of energy for that great superpower zone which is to embrace a far-flung section of the States of our northeastern seaboard. Isn't it worth our while to have at our disposal 3,500,000 horsepower without burning a single pound of coal? Can we be indifferent to undertakings that will enable us to increase vastly our productiveness while cutting the fuel bill by hundreds of millions of dollars yearly?

The Musical Hospital

(*Continued from page 270*)

Once in the hand of the violin doctor the broken pieces are tenderly taken out of the paper and an account of stock is taken to see what is missing. If the cracks are small they must be encouraged to open so a little glue can be introduced and they are then tightly bound until dry. If the wound is more severe the cracks are taken up by inserting a narrow slip of wood with plenty of stock left on the inside to shave off when dry. Small squares or "reinforcement blocks" will be noticed up and down the back and belly; these are minute plugs inserted to help fill the crack and the square tops will be planed off before gluing together and varnishing. After all traces of the accident have been obliterated the instrument is carefully assembled and glued together, complicated clamps holding it in position during the drying operation, which is never hurried. Finally, the varnish is applied and the instrument is put away in a glass case out of the dust and in a few weeks the owner almost tearfully tests its tone and goes his way rejoicing.

The Heavens in April, 1921

(*Continued from page 272*)

Draco is high in the northeast, with Lyra below and Cygnus rising. High in the east is Bootes, with Corona and Hercules below and to the left, and Ophiuchus rising to the right. Virgo is well up in the south with Hydra below and extending far to the westward.

The winter constellations are almost gone. Orion and Taurus have set; and only Canis Minor, Gemini, and Auriga remain in sight. Leo, high in the southwest and brightened by the presence of Jupiter and Saturn, completes the list of conspicuous objects.

The Planets

Mercury is a morning star all this month, but is best observable at its beginning, when he rises a little before 4 A. M. and should be easy to see. Venus begins as an evening star setting at 9 P. M. on the first, and appearing as a very beautiful crescent with so small an instrument as a powerful binocular; but she moves very rapidly into line between us and the sun, reaching her conjunction on the 22nd, so that during the last half of the month she is practically invisible.

Mars is an evening star in Aries, but is pretty low. On the 4th he is in conjunction with Venus; but as the two planets are 7½ degrees apart in declination, the phenomenon will not be striking.

Jupiter is in Leo and is admirably observable, coming to the meridian at about 9 P. M. in the middle of the month. Saturn is in the same constellation about eight degrees farther east, and is likewise conspicuous. With a powerful telescope he is an exceedingly interesting object. On April 10th the rings are turned edgewise toward the sun, and after that date we shall be looking at their dark side until the end of July, and they will be quite invisible except in the most powerful telescopes, which will show them as a faint, ghostly line, illuminated partly by light reflected from the planet and partly by sunlight transmitted through the interstices of their particles.

Uranus is a morning star in Aquarius, rising about 3:30 A. M., while Neptune is in Cancer, and comes to the meridian at 7:30 P. M. in the middle of the month.

The moon is new at 4 A. M. on the 8th, in her first quarter at 5 A. M. on the 15th, full at 2 A. M. on the 22nd, and in her last quarter at 11 P. M. on the 29th. She is nearest us on the 16th, and farthest away on the 1st and 29th. During the month she passes near Uranus on the 5th, Mercury on the 6th, Venus and Mars on the 9th, Neptune on the 16th, Jupiter on the 18th, and Saturn on the 19th.

The month is notable for two eclipses, of the sun on the 8th and of the moon on the night of the 21st-22nd. The latter is visible throughout the United States and we shall describe it on the notes page next week. The solar eclipse on the 8th is annular, and visible in Europe—also, as a partial eclipse, in northern Africa, western Asia, and Greenland. Eclipse expeditions are not usual when the eclipse is only annular, but this time Dr. Fotheringham plans to go to see whether any stars are visible with the naked eye during the semi-darkness of the annular phase, hoping thus to obtain information of value in the interpretation of ancient and medieval eclipse records.

At sea, S.S. "Aquitania,"
March 17, 1921.

An Extinct Sea Lizard from Western Kansas

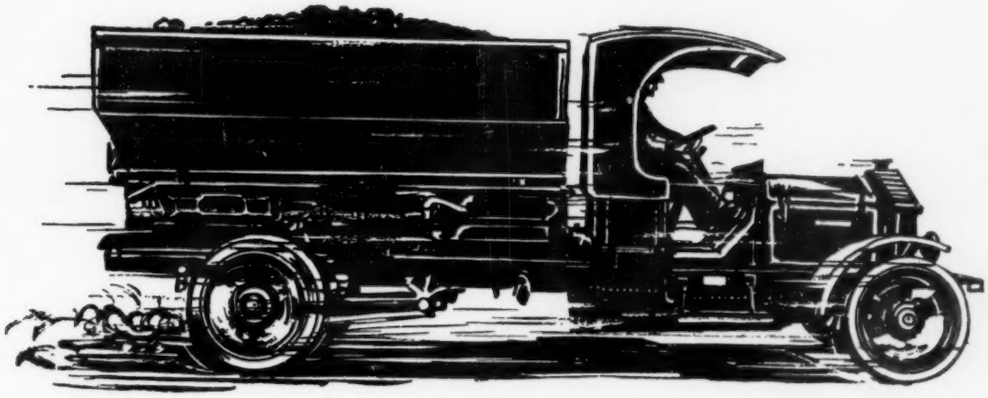
(*Continued from page 273*)

Doctor Williston, who observed on one specimen carbonized pigment, which showed that the sides of the body were marked by narrow, diagonally placed parallel bars.

One of the unique features of *Tylosaurus*, and for that matter of all mosasaurs, is an articular joint in about the middle of each lower jaw, which permits considerable movement between the front and back parts, both up and down and sideways, though chiefly in the latter direction. This feature in conjunction with their very loose attachment to one another at the forward ends allowed the jaws to expand and thus enabled them to swallow large objects, for it is certain that not all of the animals which the *Tylosaurus* devoured were small, for since their teeth were not adapted for the rending of bodies they must have been swallowed whole.

While most of the Mosasaurs were predatory animals having the jaws provided with numerous sharply pointed teeth that were well adapted for catching fish—for it is thought fish formed their principal article of diet, since fish bones and scales have been found among the fossilized stomach contents—there was another kind of Mosasaur, *Globidens alabamensis*, that formerly lived in North America and enjoyed quite a different kind of food as shown by the very peculiar shape of its teeth. Reference is made to a specimen in the National Museum found some few years ago in the northern part of the State of Alabama which has nearly spherical teeth.

Mosasaur specimens have not only been found in many parts of the United States, but in South America, Belgium, Holland, Russia, France and New Zealand, but nowhere are they more abundant or are their remains found in a more perfect state of preservation than in the chalk deposits of western Kansas.



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